

---

# Periodic Survey Evaluation: Ocean View Beach

---

Presented to:

City of Norfolk

*Fall 2013*

Prepared by:



moffatt & nichol

## Table of Contents

1. Executive Summary .....	1
2. Objective .....	4
3. Data Sources .....	5
4. Methods.....	7
5. Discussion of Periodic Surveying Evaluation.....	9
5.1. Differences in Survey Comparisons .....	9
5.2. Key Events During the Reporting Period .....	9
5.2.1. Storm Events .....	9
5.2.2. Engineering Activities.....	11
5.3. General Shoreline Trends .....	13
5.4. Regional Shoreline Trends .....	14
5.4.1. Willoughby Spit .....	14
5.4.2. 800 Block Breakwaters .....	15
5.4.3. West Ocean View .....	16
5.4.4. Central Ocean View Breakwaters .....	16
5.4.5. Central Ocean View .....	17
5.4.6. East Ocean View .....	18
5.5. East Ocean View Beach Nourishment Project (2009).....	23
5.6. Central Ocean View Dune Restoration Project (2005) .....	27
6. Summary .....	31

## Appendices

Appendix A: VIMS Aerial Photography and Digitized Shorelines

Appendix B: Survey Comparison Plots

Appendix C: Summary of Shoreline Change and Volume Change Tables

Appendix D: Engineering Activities Log



## List of Figures

Figure 3-1: Survey Baseline and Transects.....	6
Figure 5-1: April 22, 2013 Storm.....	10
Figure 5-2: West Ocean View Shoreline Improvement Project.....	12
Figure 5-3: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for September 2012 to October 2013 (Note: Positive = Accretion, Negative = Erosion) .....	19
Figure 5-4: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for September 2012 to October 2013 (Note: Positive = Accretion, Negative = Erosion) .....	20
Figure 5-5: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for April 2013 to October 2013 (Note: Positive = Accretion, Negative = Erosion) .....	21
Figure 5-6: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for April 2013 to October 2013 (Note: Positive = Accretion, Negative = Erosion) .....	22
Figure 5-7: Net Volume Change Since the East Ocean View Nourishment Project (March 2009) ....	25
Figure 5-8: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and October 2013 Shorelines for East Ocean View.....	26
Figure 5-9: Net Volume Change Since the Willoughby Spit to Central Ocean View Dune Restoration Project (March 2005) .....	29
Figure 5-10: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and October 2013 Shorelines for Central Ocean View.....	30

## List of Tables

Table 2-1: Surveyors and Collection Dates.....	4
Table 5-1: Monthly Wave Statistics Summary .....	11
Table 5-2: Regional Shoreline and Volume Change Statistics (September 2012 to October 2013)....	13
Table 5-3: Regional Shoreline and Volume Change Statistics (April 2013 to October 2013) .....	14
Table 5-4: Average Shoreline and Volume Change Rates for Willoughby Spit.....	15
Table 5-5: Average Shoreline and Volume Change Rates for 800 Block Breakwaters.....	15
Table 5-6: Average Shoreline and Volume Change Rates for West Ocean View .....	16

Table 5-7: Average Shoreline and Volume Change Rates for Central Ocean View Breakwaters .....	17
Table 5-8: Average Shoreline and Volume Change Rates for Central Ocean View .....	17
Table 5-9: Average Shoreline and Volume Change Rates for East Ocean View .....	18
Table 5-10: Overall Shoreline and Volume Change Statistics – East Ocean View Nourishment Project (March 2009 Post-Fill – October 2013 Comparison).....	23
Table 5-11: Regional and Overall Shoreline and Volume Change Statistics for Central Ocean View Nourishment Project (March 2005 Post-Fill – October 2013 Comparison) .....	27

## 1. Executive Summary

In October 2013 Geodynamics, LLC conducted the seventeenth survey of the Ocean View shoreline. The study area extends from the western end of Willoughby Spit to the western edge of the Little Creek Inlet in East Ocean View. The periodic surveys are collected bi-annually in March/April and September/October to assess the condition of the shoreline and the state of existing shore protection projects. A baseline and transects were established with the first survey in September 2005 and have been used for each subsequent survey. Shoreline changes at Mean High Water (MHW) and volumetric changes above 0 feet NAVD88 and -15 feet NAVD88 are calculated at each transect. Differences in the region above 0 feet NAVD88 are indicative of changes to the dune and subaerial beach berm, while the differences above -15 feet NAVD88 indicate changes in the nearshore zone. Comparison of seasonal surveys (i.e. September 2012 to October 2013) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons are useful to assess the direct impact of extreme events which may occur during the six month period between surveys. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the October 2013 survey data with previous surveys taken in September 2012 (fall to fall comparison) and April 2013 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

Comparison	Parameter	Quantity
September 2012 vs. October 2013	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-7.05 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	-37,133 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	63,140 cy/yr
April 2013 vs. October 2013	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-2.69 ft
	Cumulative Volume Change Above 0 ft NAVD88	-35,890 cy
	Cumulative Volume Change Above -15 ft NAVD88	-85,217 cy

The average shoreline change rate for the entire shoreline at MHW between the September 2012 and October 2013 surveys was -7.05 ft/yr, and the cumulative volume change above 0 feet NAVD88 was approximately -37,133 cy/yr. This indicates an overall volumetric loss in the dune and subaerial beach over the past year. The overall gain above -15 feet NAVD88 of 63,140 cy/yr indicates that while there were losses on the dune and subaerial beach, there was sediment gain across the nearshore system. The most recent period of comparison, from the April 2013 survey to the October 2013 survey depicts an overall loss at the MHW line of -2.69 ft. The cumulative volume change above 0 ft NAVD88 indicates a sediment loss to the subaerial beach of -35,890 cy, which accounts for the majority of the loss throughout the entire year. There was also a loss of sediment in the nearshore system above -15 feet NAVD88 of -85,217 cy.

While the shoreline showed overall volume losses for the year, there was variability within the various regions. The Willoughby Spit region is still feeling the effects from the equilibration of the Willoughby Spit Shoreline Improvement Project, which finished construction in December 2013. The most significant gains over the year occurred in the eastern end of the Willoughby Spit reach due to a dune nourishment. The major losses in this reach were located at the vacant City land just east of the corner of Lea View Avenue and 15<sup>th</sup> View Street, as this was the sand source for the nourishment

project. The improvement project also included the construction of seven additional nearshore breakwaters, with a breakwater signature starting to become noticeable during this survey.

In the 800 Block region, there has been a net loss of sediment above 0 feet NAVD88 and -15 feet NAVD88 and erosion of the MHW shoreline. The tombolo located at the realigned breakwater has remained detached allowing sand to transport freely through this reach.

The West Ocean View shoreline improvement project has begun during the most recent survey period. The patterns of sediment gains/losses in the West Ocean View region during the most recent period shows higher erosion rates offshore at the west end of the region. This area is closest to the Central Ocean View Breakwaters and is likely affected by these structures.

The Central Ocean View Breakwaters region showed losses in the MHW shoreline position; however, gains in sediment volume over the year. The smaller gains in volume above 0 feet NAVD88 in the most recent survey period, April 2013 to October 2013, indicate that majority of the gains occurred during the winter season, which is likely due to quiescent weather.

The Central Ocean View has experienced erosion of the MHW shoreline, with a volumetric loss above 0 feet NAVD88 and a volumetric gain above -15 feet NAVD88 over the past year. The majority of the volumetric loss above 0 feet NAVD88 occurred during the most recent survey period.

As expected, due to the direction of sediment movement, there were continued volume losses to the beach in the East Ocean View region between the September 2012 and October 2013 period. During the most recent survey period there were more significant losses above -15 feet NAVD88 compared to the overall year. The Bay Oaks breakwaters are performing well, trapping sediment and eliminating the hotspot at this location. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source. The profiles have a fairly steady pattern of accretion on the profiles behind the breakwaters and erosion on the profiles between the breakwaters showing the influence of the breakwaters on decreasing the wave heights and retaining sediment along the shore.

In addition to regional assessments, comparison of the October 2013 survey was made against post-fill surveys from the East Ocean View beach nourishment and Willoughby Spit to Central Ocean View dune restoration which took place in March 2009 and January-March 2005 respectively.

Comparison	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above 15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
East Ocean View Nourishment vs. October 2013	-90.83 ft	-17.87 cy/ft	-93,016 cy	-29.37 cy/ft	-152,100 cy
Central Ocean View Nourishment vs. October 2013	-30.02 ft	-11.83 cy/ft	-221,166 cy	-8.59 cy/ft	-156,523 cy

Since the East Ocean View Nourishment project in 2009, roughly 82% of the placed material above 0 feet NAVD88 has been lost. Since the Central Ocean View Nourishment project in 2005, roughly 69% of the placed material above 0 feet NAVD88 has been lost. The Willoughby Spit shoreline

improvement project has alleviated a majority of the areas of concern in this reach. The West Ocean View shoreline improvement project is currently under way and should replenish this area and alleviate hotspots, while East Ocean View may need renourishment in the next 1-2 years.

## 2. Objective

The City of Norfolk, Virginia has maintained a program of periodic surveying of the Ocean View shoreline since 2005. The periodic surveying data collection dates are shown in Table 2-1. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the October 2013 survey data with previous surveys taken in September 2012 (fall to fall comparison) and April 2013 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet. In addition, comparison of the most recent survey (October 2013) was made to pre-fill and post-fill surveys from the Central Ocean View beach nourishment project that took place in January-March 2005 and the most recent East Ocean View beach nourishment project which took place in March 2009.

**Table 2-1: Surveyors and Collection Dates**

Data Collection Date	Surveyor
September 2005	McKim & Creed
March 2006	McKim & Creed
October 2006	McKim & Creed
March 2007	McKim & Creed
October 2007	McKim & Creed
March 2008	McKim & Creed
October 2008	McKim & Creed
April 2009	McKim & Creed
October 2009	Geodynamics, LLC
March 2010	Geodynamics, LLC
October 2010	Geodynamics, LLC
April 2011	Geodynamics, LLC
October 2011	Geodynamics, LLC
March 2012	Geodynamics, LLC
September 2012	Geodynamics, LLC
April 2013	Geodynamics, LLC
October 2013	Geodynamics, LLC

### 3. Data Sources

Geodynamics, LLC, conducted the most recent survey of Ocean View Beach in October 2013. The baseline and transects established for the September 2005 survey were used for the most recent survey. Figure 3-1 shows the location of the baseline, transects and the stationing applied by Geodynamics for the surveying. As shown in Figure 3-1, transects were stationed from west to east along the Ocean View shoreline. The survey data were provided in xyz and shapefile formats allowing for compatibility with multiple programs.

Geodynamics noted that typical survey accuracy along the hydrographic portions of the profiles is approximately  $\pm 1$  cm. This ‘margin of error’, if applied over the entire length of the hydrographic profiles can potentially result in significant volumetric differences, in particular on the shallow and long profiles near Willoughby Spit. Therefore, volumetric changes discussed herein are analyzed with regard to potential volumetric margins of error.

Also in October 2013, the Virginia Institute of Marine Science (VIMS) flew aerial photography of the Ocean View shoreline, georectified the images, and digitized a shoreline position from the images. The October 2013 aerial photos with the digitized shoreline positions from October 2013, April 2013, and September 2012 are presented in Appendix A. Since these photos cover a limited portion of area landward and seaward of the shoreline, a previous image (2009) is underlain, for presentation purposes.

Pre- and post-fill survey data from the East Ocean View beach nourishment, collected in June 2003 and March 2009, respectively, were used as baseline data for assessing the current state of that nourishment project. Similarly, pre- and post-fill survey data from the Willoughby Spit to Central Ocean View dune restoration were utilized; these surveys were collected in December 2004 – February 2005 and March 2005, respectively. Pre-fill and post-fill data were available in xyz format from previous studies of these projects by Moffatt & Nichol.





Figure 3-1: Survey Baseline and Transects



## 4. Methods

Survey comparisons and respective analysis were performed using a combination of Autodesk Civil 3D 2012 (Civil 3D), Microsoft Excel (Excel), Surfer and the USACE's Beach Morphology Analysis Package (BMAP). Civil 3D is an AutoCAD based program which allows the user to create and analyze Digital Terrain Models (DTMs). Surfer is a contouring and 3D surface mapping program utilized to create 3D surfaces for analysis. BMAP is a program developed by the USACE to analyze morphologic and dynamic properties of beach profiles.

All pertinent survey data were imported into Civil 3D in xyz format. The horizontal coordinate system used was Virginia South State Plane NAD 1983 (HARN), US Survey feet with a vertical datum of NAVD88. DTMs were created for each set of survey data, and a beach profile was extracted at each survey transect in station-elevation format. Individual profile plates showing the extracted profile at each transect for each date are presented in Appendix B. From the profiles, shoreline change and volumetric change were then calculated at each transect for the following time periods:

1. September 2012 to October 2013 (Entire Shoreline)
2. April 2013 to October 2013 (Entire Shoreline)
3. March 2009 (East Ocean View post-fill) to October 2013 (Sta 329+63 through Sta 383+58)
4. March 2005 (Central Ocean View post-fill) to October 2013 (Sta 15+00 through Sta 195+63)
5. December 2004-February 2005 (Central Ocean View pre-fill) to October 2013 (Sta 15+00 through Sta 195+63)
6. June 2003 (East Ocean View pre-fill) to October 2013 (Sta 329+63 through Sta 383+58)

First, the change in shoreline based on the profiles extracted from Civil 3D at mean high water (MHW) was calculated at each transect for each time period mentioned. MHW along Ocean View beaches is defined as +0.98 feet NAVD88 based on NOAA tidal benchmark at Sewells Point. The resulting value represents the shoreline change (feet) over the time period between surveys. The shoreline change rate (ft/yr) was then calculated by dividing by the amount of time between survey dates.

Representative volume changes were also calculated at each transect for all time periods. Volume changes were calculated for two different extents in order to better understand the processes occurring onshore and offshore of the Ocean View beach area. Calculations included volume change above -15 feet NAVD88 and volume change above 0 feet NAVD88. The results represent volume change per linear foot of shoreline (cy/ft) over the period of time between surveys. The volume change rate (cy/ft/yr) was then calculated by dividing by the amount of time between survey dates. In addition, the volume changes were converted to cumulative changes over the entire shoreline. This was done by applying the average end area method to the unit volume changes (cy/ft) and unit volume change rates (cy/ft/yr) computed at each transect and summing the total volume changes over

the entire shoreline. The resulting value indicated the total loss or gain of material (cy) between surveys based on the applicable profile extents.

Volume changes calculated for portions of the profiles above 0 feet NAVD88 are representative of changes in the amount of material in the dune system and on the subaerial beach. These areas are highly influenced by the performance of coastal structures and the impact of storm activity. Volume changes calculated for portions of the profiles above -15 feet NAVD88 allow for the tracking of sand movement offshore while reducing the amount of uncertainty associated with hydrographic data beyond this depth.

## 5. Discussion of Periodic Surveying Evaluation

This section discusses differences observed between the noted surveys, overall shoreline trends, regional shoreline trends and the East Ocean View and Central Ocean View nourishment projects. The computed shoreline changes and volume changes at each individual transect for the time periods covered are tabulated in Appendix C.

### 5.1. Differences in Survey Comparisons

Profile variations in the surveys taken as part of the ongoing program of periodic surveying of the Ocean View shoreline (September 2012, April 2013 and October 2013) were minimal in the topographic portion of the survey due to use of the same baseline and transects put in place for the initial survey in September 2005. Profile extents and alignment were virtually the same when comparing the survey data. The only discrepancy which impacted calculations was the vertical margin of error in the hydrographic portion of the survey as mentioned in Section 3.

The pre-fill and post-fill surveys taken for the East Ocean View and Central Ocean View nourishment projects did not use the same baseline and transects or cover the same extents as the periodic surveys. Therefore, the profiles extracted from the DTMs in Civil 3D at the periodic surveying transects are interpolations between the actual pre- and post-fill data points. In addition, the surveys did not extend as far offshore as the periodic surveys, limiting computations and the ability to track the offshore movement of sand.

### 5.2. Key Events During the Reporting Period

Beach processes are greatly influenced by natural and engineering processes. This section describes key events that happened during the reporting period which likely had an impact on the changes in shoreline position as well as profile volume gains and losses.

#### 5.2.1. Storm Events

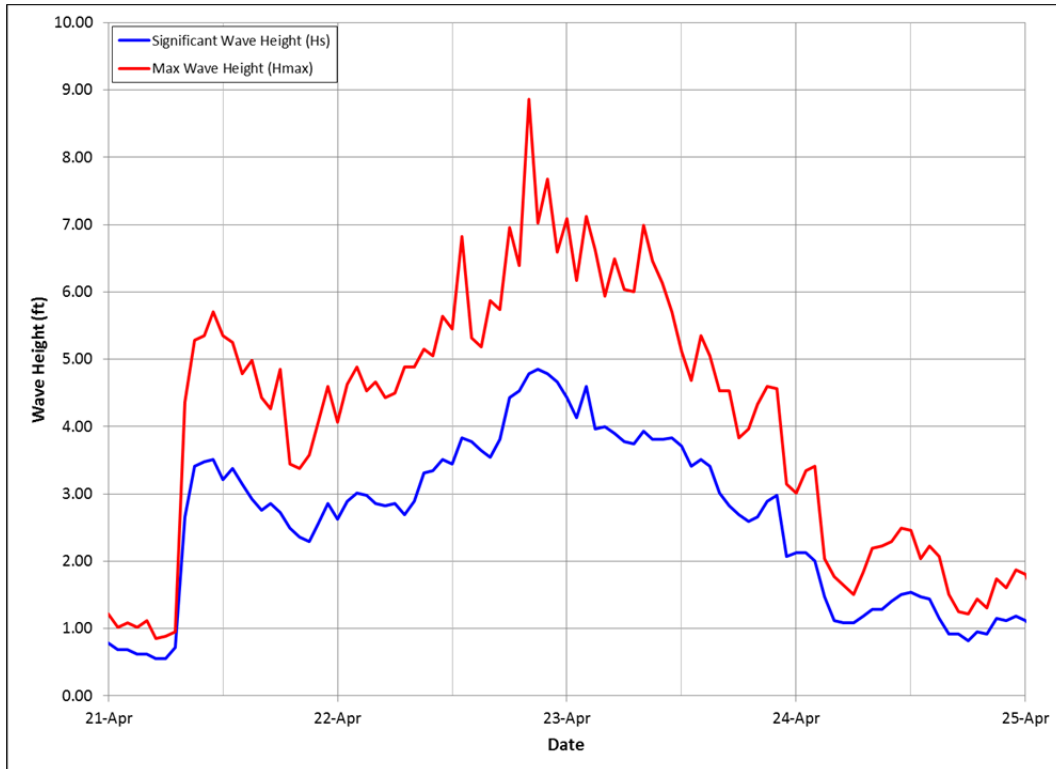
Understanding of the wave climate immediately offshore of the Norfolk shoreline is vital for the design, monitoring, and understanding of projects along the shoreline and the behavior of the beach. The data used was collected from the City's AWAC (Acoustic Wave and Current) gage, which was deployed in 2006 directly offshore of the Norfolk Shoreline in approximately 23 feet of water. The dates that the wave data was collected during this survey period were between April 1, 2013 and September 10, 2013.

A summary of the observed conditions during this deployment period yields the following general observations:

- The average significant wave height and peak period over the measurement period was approximately 1.0 feet and 5.3 seconds.
- The typical direction of the waves was from the northeast to southeast.

- The largest significant wave height observed during this deployment was approximately 4.9 feet with a corresponding peak period of approximately 4.6 seconds and mean direction of 28.7 degrees (April 22, 2013).

The data indicates that only one event occurred during this period for which the significant wave height reached or exceeded 1.5 meters (4.9 feet). This event occurred on April 22, 2013. The significant wave height for the April 22, 2013 storm reached 1.5 meters (4.9 feet) with a maximum wave height of 2.7 meters (8.9 feet) as shown in Figure 5-1. The duration for this storm was 1 hour with significant wave heights reaching 1.5 meters.



**Figure 5-1: April 22, 2013 Storm**

The 2013 hurricane season was unusually mild with no hurricanes impacting the ocean view shoreline. The nor'easter season was also fairly inactive with only one storm of significance with a short duration, which mostly likely did not have much impact on the beach. A summary of wave statistics by month during this deployment is given in

**Table 5-1.** Please refer to the Spring 2013 monitoring report to see the wave climate between September 2012 and April 2013.

**Table 5-1: Monthly Wave Statistics Summary**

Wave Statistic	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
Average Significant Wave Height, $H_s$ (ft)	1.4	1.0	1.0	0.8	1.1	0.9
Average Wave Period, $T_m$ (s)	2.6	2.4	2.3	2.4	2.5	2.5
Average Peak Wave Period, $T_p$ (s)	4.9	4.6	5.2	5.8	5.5	5.7
Maximum Observed Significant Wave Height, $H_s$ (ft)	4.9	4.1	3.4	2.8	3.5	3.0
Maximum Observed Wave Height, $H_{max}$ (ft)	8.9	7.1	5.5	5.5	6.0	5.7

### 5.2.2. Engineering Activities

Within the most recent survey period (April 2013 to October 2013), the West Ocean View Shoreline Improvement Project began. This project includes the removal of the existing groin field east of the pier, reconstruction of a new groin in between the 200 Block and Sarah Constant Shrine Park, and a 35,000 cy nourishment project, as shown below in Figure 5-2. The new groin is designed to be shorter and tighter than the previous groins, helping to maintain the beach width in front of the 200 Block adequately for vehicle access. The 35,000 cy nourishment project would add 30 ft of berm width in front of Sarah Constant Shrine Park, on the downdrift side of the groin. More nourishment is needed in front of the park to mitigate the downdrift erosional effects of the new groin. A complete list of the historical engineering activities that have occurred in this region is shown in Appendix D.

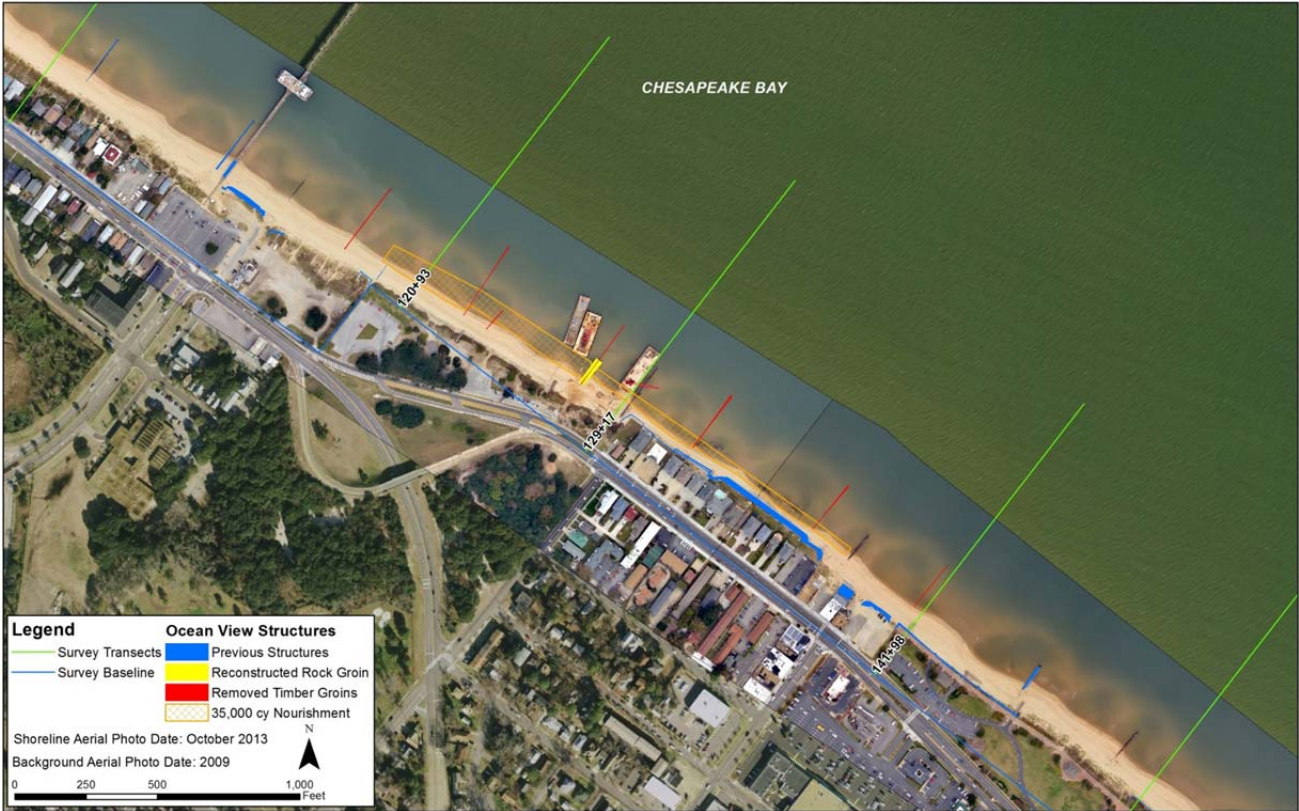


Figure 5-2: West Ocean View Shoreline Improvement Project



### 5.3. General Shoreline Trends

Key statistics were calculated to describe the average shoreline and volume changes over the entire shoreline as well as for each region of the shoreline as defined in Figure 3-1. The computed statistics include average shoreline change, average volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). A summary of the resulting statistics for the March 2012 to April 2013 comparison are presented in Table 5-2. A summary of the resulting statistics for the September 2012 to April 2013 comparison are presented in Table 5-3. Evaluation of the computed statistics took into account volume changes computed for portions of the profile above 0 feet NAVD88 and above -15 feet NAVD88 in order to better understand onshore and offshore processes.

According to Table 5-2, the Ocean View shoreline has experienced overall losses at MHW over the past year with a change rate of -7.05 feet per year. While the beach lost a minor amount of material above 0 feet NAVD88, there was an overall gain of material in the system with a change rate of 63,140 cy/yr.

While the overall trends over the past year show shoreline erosion and volumetric accretion of the system, patterns vary within each region of the shoreline as defined in Figure 3-1. The calculated statistics with respect to each region will be discussed in more detail in the following section.

**Table 5-2: Regional Shoreline and Volume Change Statistics (September 2012 to October 2013)**

Region	Average Shoreline Change Rate	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	4.87	1.48	4,712	6.39	26,049
800 Block Breakwaters (45+25 to 87+62)	-9.05	-2.03	-9,518	-0.55	-4,634
West Ocean View (93+41 to 163+49)	-2.25	-0.43	-3,543	1.32	6,579
Central Ocean View Breakwaters (169+63 to 195+63)	-4.26	1.09	3,748	1.73	6,657
Central Ocean View (206+86 to 323+09)	-11.63	-1.71	-20,042	2.91	37,694
East Ocean View (329+63 to 383+58)	-12.93	-2.14	-12,489	-1.74	-9,206
OVERALL	Weighted Average (ft/yr)	Weighted Average (cy/ft/yr)	Total (cy/yr)	Weighted Average (cy/ft/yr)	Total (cy/yr)
	-7.05	-0.93	-37,133	1.79	63,140

**Table 5-3: Regional Shoreline and Volume Change Statistics (April 2013 to October 2013)**

Region	Average Shoreline Change	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	4.97	0.17	-1,291	-4.40	-19,944
800 Block Breakwaters (45+25 to 87+62)	-7.77	-1.04	-4,981	-3.94	-19,031
West Ocean View (93+41 to 163+49)	2.63	0.24	703	-0.58	-8,182
Central Ocean View Breakwaters (169+63 to 195+63)	-3.28	-0.02	606	-1.33	-1,381
Central Ocean View (206+86 to 323+09)	-4.88	-2.00	-23,412	-1.41	-14,227
East Ocean View (329+63 to 383+58)	-6.65	-1.25	-7,514	-3.72	-22,452
OVERALL	Weighted Average (ft)	Weighted Average (cy/ft)	Total (cy)	Weighted Average (cy/ft)	Total (cy)
	-2.69	-0.90	-35,890	-2.23	-85,217

## 5.4. Regional Shoreline Trends

Regional shoreline trends are discussed below for the defined regions between Willoughby Spit and Little Creek Inlet (see Figure 3-1). A summary of the information in Table 5-2 and Table 5-3 has been created for each region of study. Figure 5-3 through Figure 5-6, following the discussion of regional shoreline trends, present the shoreline and volume change at each transect within the defined regions.

### 5.4.1. Willoughby Spit

The Willoughby Spit region (Sta 0+00 to Sta 45+00) previously included two offshore breakwaters, timber groins and has historically been a stable and accreting region. Since the completion of the Willoughby Spit Shoreline Improvement Project in December 2013, this region is still experiencing the effects of equilibration from the project. A summary of average shoreline and volume change rates for the Willoughby Spit region between September 2012 and October 2013 and between April 2013 and October 2013 are presented in Table 5-4.



**Table 5-4: Average Shoreline and Volume Change Rates for Willoughby Spit**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>September 2012 vs. October 2013 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	4.87	1.48	4,712	6.39	26,049
<b>April 2013 vs. October 2013 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	4.97	0.17	-1,291	-4.40	-19,944

The information depicted in Table 5-4 shows the influence of the recent Willoughby Spit Shoreline Improvement Project on this region over the last year. The shoreline at MHW as well as the volume change above 0 feet NAVD88 and -15 feet NAVD88 was highly variable throughout this reach. For the year between the fall surveys (September 2012 and October 2013), this region experienced overall accretion of the MHW shoreline as well as an overall gain of sediment above 0 ft NAVD88 and 26,049 cy/yr above -15 ft NAVD88. The eastern and western ends of the reach experienced large volume gains while the central section experienced high volume losses as shown in Figure 5-3 and Figure 5-4. The effects from the equilibration of the nourishment placement, the removal of the timber groins, and the construction of the breakwater field can be seen over the past survey period (April 2013 to October 2013) in the high variation in volume change and shoreline change in Figure 5-5 and Figure 5-6.

#### 5.4.2. 800 Block Breakwaters

The 800 Block Breakwaters region (Sta 45+25 to Sta 87+62) is characterized by a field of eight breakwaters. The easternmost breakwater was relocated in February 2006 along with removal of the pre-existing groin spur and toe extension. This new breakwater was built further offshore since the previous structural configuration caused the beach to fill out and impair natural sediment transport to the west. The breakwater just west of the newly relocated easternmost breakwater developed a tombolo after the relocation so, as a part of the Willoughby Spit Project Shoreline Improvement Project, this second breakwater from the east has been relocated further offshore to enhance natural sediment transport in the region. A summary of average shoreline and volume change rates for the 800 Block Breakwaters region between September 2012 and October 2013 and between April 2013 and October 2013 are presented in Table 5-5.

**Table 5-5: Average Shoreline and Volume Change Rates for 800 Block Breakwaters**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>September 2012 vs. October 2013 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
800 Block Breakwaters (45+25 to 87+62)	-9.05	-2.03	-9,518	-0.55	-4,634
<b>April 2013 vs. October 2013 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
800 Block Breakwaters (45+25 to 87+62)	-7.77	-1.04	-4,981	-3.94	-19,031

Overall, the shoreline change and the volume change above 0 feet NAVD88 and -15 ft NAVD88 have, on average, continued to erode within this reach over the past monitoring cycle. Since the realignment of the second breakwater from the east, the tombolo previously found landward of this breakwater has changed to a salient allowing the natural flow of sediment to resume to this location which is expected to eventually equilibrate. This process is visible in Figure 5-5 and Figure 5-6 by the shoreline erosion and volume loss at station 73+62 and by the shoreline accretion and volume gain at station 71+62.

#### 5.4.3. West Ocean View

The West Ocean View area (Sta 93+41 to Sta 163+49), between the 800 Block and Central Ocean View breakwaters, is characterized by a series of timber groins. A summary of average shoreline and volume change rates for the West Ocean View region between September 2012 and October 2013 and between April 2013 and October 2013 are presented in Table 5-6.

**Table 5-6: Average Shoreline and Volume Change Rates for West Ocean View**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>September 2012 vs. October 2013 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
West Ocean View (93+41 to 163+49)	-2.25	-0.43	-3,543	1.32	6,579
<b>April 2013 vs. October 2013 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
West Ocean View (93+41 to 163+49)	2.63	0.24	703	-0.58	-8,182

The September 2012 to October 2013 survey comparison showed a minor retreat of the MHW shoreline position, with overall volume loss above elevation 0 ft NAVD88 and an overall volume gain above -15 ft NAVD88. The majority of the retreat of the MHW shoreline occurred between September 2012 and April 2013. During the current survey, the West Ocean View Shoreline Improvement Project began construction. At the time of survey, all timber groins had been removed and the reconstruction of the rock groin at station 129+17 had begun; however, the 35,000 cy nourishment had not yet been placed. This reach experienced accretion of the MHW shoreline and overall sediment volume gains above elevation 0 ft NAVD88. The volume change above -15 feet NAVD88 started began eroding, which occurred predominantly in the western section of this reach as shown in Figure 5-6.

#### 5.4.4. Central Ocean View Breakwaters

The Central Ocean View breakwater region covers the four offshore breakwaters at Central Ocean View and approximately 800 feet westward (Sta 169+63 to Sta 195+63). A summary of average shoreline and volume change rates for the Central Ocean View Breakwaters region between September 2012 and October 2013 and between April 2013 and October 2013 are presented in Table 5-7.

**Table 5-7: Average Shoreline and Volume Change Rates for Central Ocean View Breakwaters**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>September 2012 vs. October 2013 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View Breakwaters (169+63 to 195+63)	-4.26	1.09	3,748	1.73	6,657
<b>April 2013 vs. October 2013 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View Breakwaters (169+63 to 195+63)	-3.28	-0.02	606	-1.33	-1,381

The Central Ocean View Breakwaters region showed a retreat of the MHW shoreline position; however, there were gains in sediment volume above 0 feet NAVD88 and -15 feet NAVD88 over the past year. The smaller gains in volume above 0 feet NAVD88 in the most recent survey period, September 2012 to April 2013, indicate that majority of the gains occurred during the spring season, which is likely due to the quiescent winter wave climate. The end effects of the breakwater field are apparent in the losses at MHW at Sta 175+63 and Sta 177+63 shown in Figure 5-3 and Figure 5-5 as well as sediment volume losses depicted in Figure 5-4 and Figure 5-6.

#### 5.4.5. Central Ocean View

Central Ocean View (Sta 206+86 to Sta 323+09) is historically a stable region with slight accretion despite the absence of engineering interventions (e.g. beach fill or structures). A summary of average shoreline and volume change rates for the Central Ocean View region between September 2012 and October 2013 and between April 2013 and October 2013 are presented in Table 5-8.

**Table 5-8: Average Shoreline and Volume Change Rates for Central Ocean View**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>September 2012 vs. October 2013 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View (206+86 to 323+09)	-11.63	-1.71	-20,042	2.91	37,694
<b>April 2013 vs. October 2013 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View (206+86 to 323+09)	-4.88	-2.00	-23,412	-1.41	-14,227

As shown in Table 5-8, Central Ocean View has experienced erosion at the MHW shoreline, a volumetric loss in sediment above 0 feet NAVD88 and a volumetric gain in sediment above -15 feet NAVD88 over the past year. The majority of the volumetric loss above 0 feet NAVD88 occurred during the period from April 2013 to October 2013. Assessment of Figure 5-4 and Figure 5-6 shows the majority of these losses that occurred to the subaerial beach berm above 0 feet NAVD88 moved offshore. This loss in berm width correlates to an overall erosion of the MHW shoreline as shown in Figure 5-3 and Figure 5-5.

#### 5.4.6. East Ocean View

The East Ocean View region (Sta 329+63 to Sta 383+58) is characterized by 15 breakwaters of which the 5 westernmost were built in August of 2009. Prior to the breakwater construction, a beach renourishment project took place in March 2009, adding approximately 196,000 cy of material to the beach. A summary of average shoreline and volume change rates for the East Ocean View region between September 2012 and October 2013 and between April 2013 and October 2013 are presented in Table 5-9.

**Table 5-9: Average Shoreline and Volume Change Rates for East Ocean View**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>September 2012 vs. October 2013 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
East Ocean View (329+63 to 383+58)	-12.93	-2.14	-12,489	-1.74	-9,206
<b>April 2013 vs. October 2013 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
East Ocean View (329+63 to 383+58)	-6.65	-1.25	-7,514	-3.72	-22,452

As expected, due to sediment movement along the shoreline from east to west, there were continued volume losses to the beach and erosion of the MHW shoreline in this region between September 2012 and October 2013. Figure 5-4 indicates the Bay Oaks breakwaters have continued to be very successful at trapping sand that may be eroding from the beach and eliminating the previous hotspot. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source and the littoral sediment movement in this region going from east to west. The region has a fairly steady pattern of accretion on the profiles behind the breakwaters and erosion on the profiles between the breakwaters. This indicates the influence of the breakwaters on decreasing the wave heights and retaining sediment along the shore.

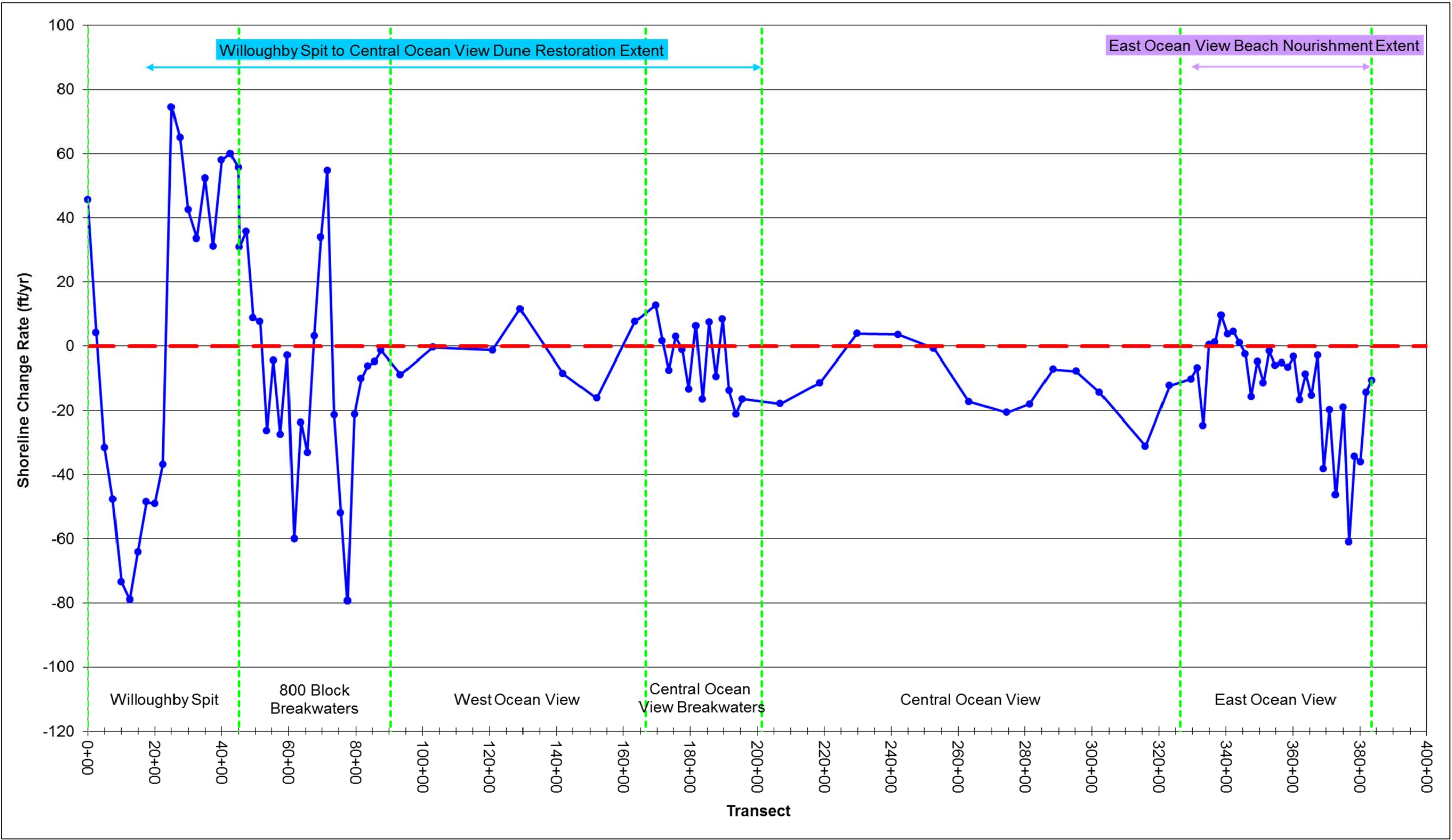


Figure 5-3: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for September 2012 to October 2013 (Note: Positive = Accretion, Negative = Erosion)



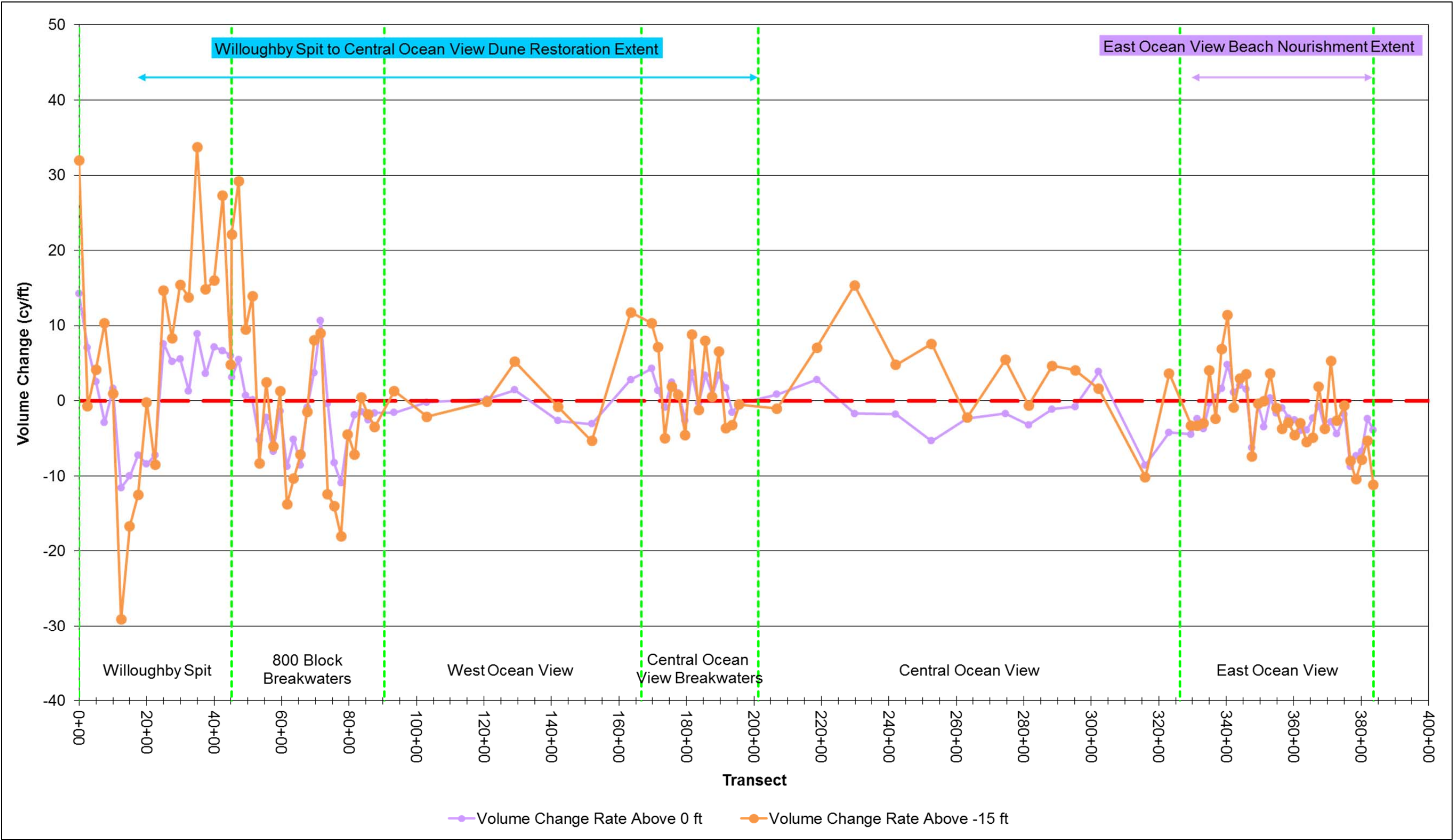


Figure 5-4: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for September 2012 to October 2013 (Note: Positive = Accretion, Negative = Erosion)

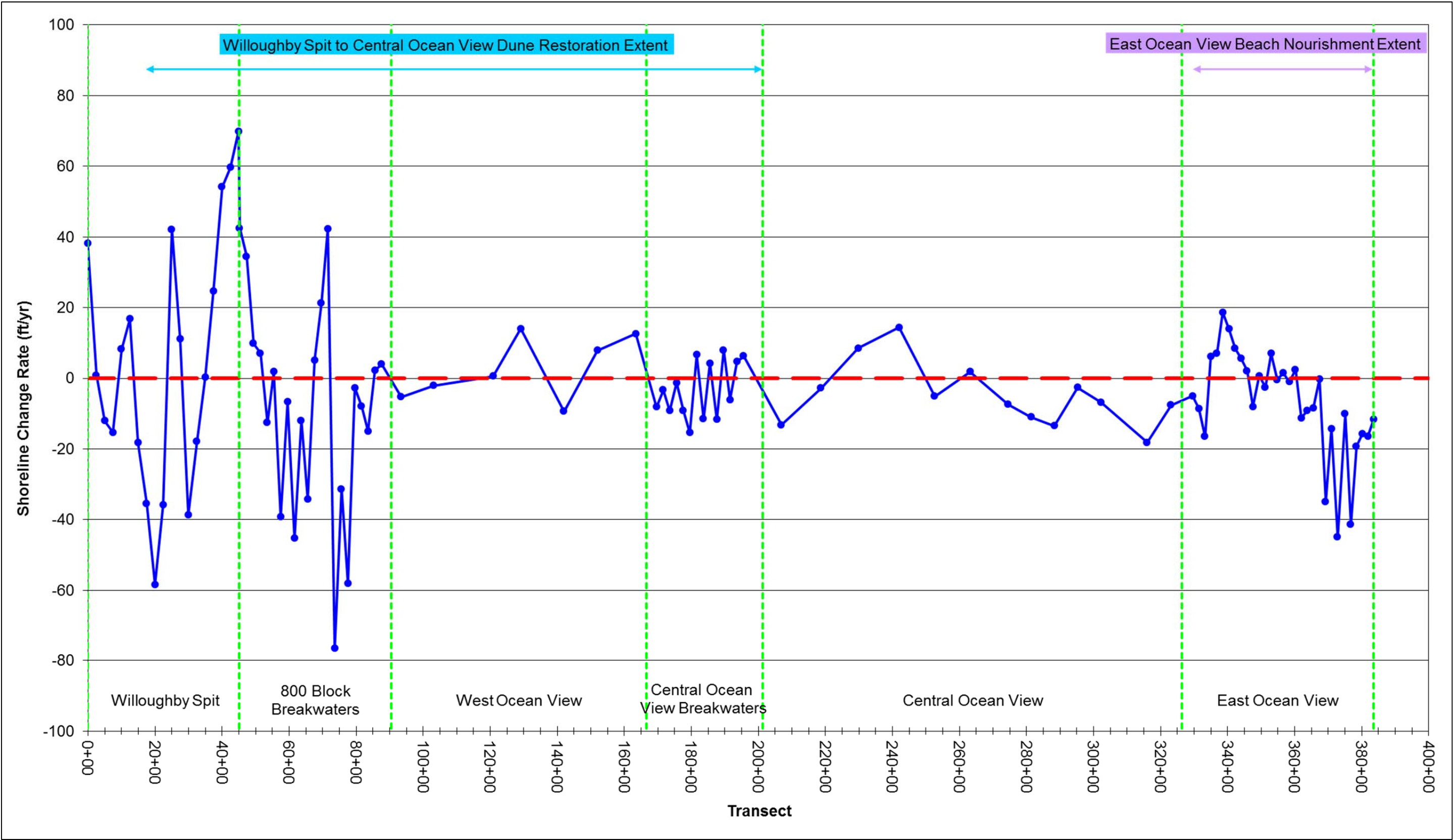


Figure 5-5: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for April 2013 to October 2013 (Note: Positive = Accretion, Negative = Erosion)

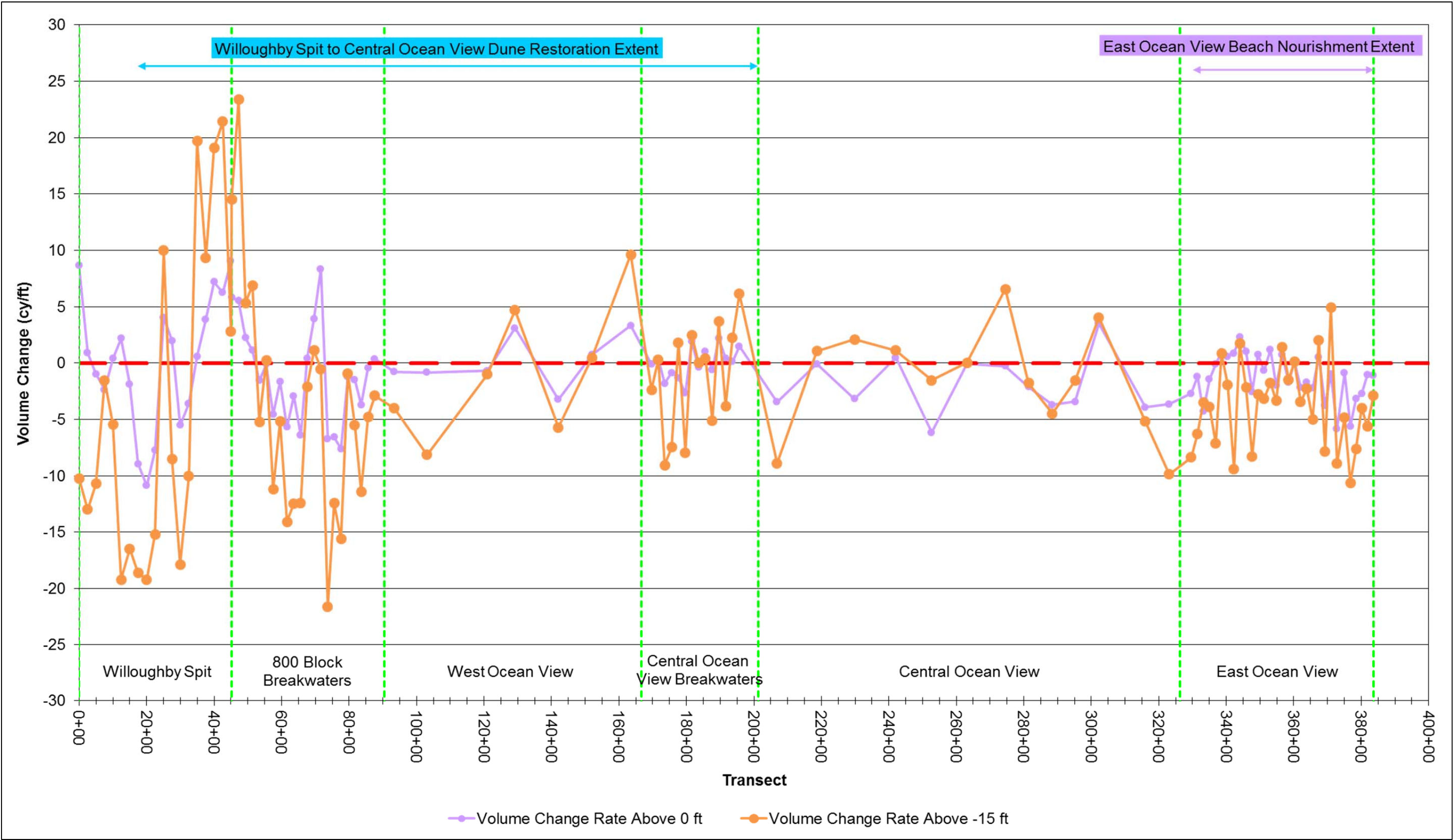


Figure 5-6: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for April 2013 to October 2013 (Note: Positive = Accretion, Negative = Erosion)



## 5.5. East Ocean View Beach Nourishment Project (2009)

An initial beach nourishment project took place along the East Ocean View shoreline in November 2003. Approximately 359,000 cy of material was placed on the beach between Sta 329+63 and Sta 383+58. More recently, the East Ocean View shoreline was renourished with approximately 196,000 cy of material in March 2009. The most recent periodic survey, conducted in April 2013, was compared to the post-fill survey taken in March 2009. Table 5-10 presents the shoreline and volume change statistics comparing the two surveys.

**Table 5-10: Overall Shoreline and Volume Change Statistics – East Ocean View Nourishment Project (March 2009 Post-Fill – October 2013 Comparison)**

Region		Average Shoreline Change (ft)	Average Volume Change Above 0 ft NAVD88 (cy/ft)	Cumulative Volume Change Above 0 ft NAVD88 (cy)	Average Volume Change Above -15 ft NAVD88 (cy/ft)	Cumulative Volume Change Above -15 ft NAVD88 (cy)
East Ocean View (329+63 to 383+58)	Rate per Year	-19.83	-3.90	-20,306	-6.41	-33,204
	Total	-90.83	-17.87	-93,016	-29.37	-152,100

Results indicate that the East Ocean View shoreline has continued eroding with losses at MHW. Roughly 93,000 cy of material has been lost above 0 feet NAVD88, or approximately 82% of the 113,000 cy originally placed above 0 feet NAVD88. This loss of sediment is the result of the expected erosion due to design life of the nourishment project combined with storm activity. Previous experience from the 2003 nourishment project indicates that the design life of projects in this area is limited to 4-5 years due to storm impact and lack of sediment source to the east. Therefore, it is anticipated that renourishment will likely be needed within the next 1 to 2 years.

Figure 5-7 shows areas of elevation change between the post-fill survey and the October 2013 survey. As depicted in the figure, there has been erosion of the beach face and nearshore in-between the breakwaters with some of that sediment being trapped behind each of the breakwaters. The magnitude of the loss is much larger to the east, which is to be expected since this shoreline is cut off from a sediment source by the jetty. Some of the sediment eroded from the beach face and nearshore appears to be caught offshore in the vicinity of the Bay Oaks breakwaters. At station 329+63, there are slight end effects from the Bay Oaks breakwaters. These breakwaters have been very successful, eliminating the previous hotspot and providing a transition into the Central Ocean View region. There has also been an increase in the dune area, which may partially be attributed to the annual dune planting project providing a mechanism for sand accumulation.

In addition, the October 2013 MHW shoreline was compared to the MHW shoreline from June 2003, before the first nourishment project in November 2003, as another way to measure the amount of protection being supplied by the March 2009 nourishment project. Areas where the current shoreline is within 20 feet of the June 2003 shoreline need to be targeted for nourishment. Figure 5-8 shows the MHW shoreline position difference between the June 2003 pre-fill and October 2013 shorelines. As can be seen, the MHW shoreline at a majority of transects along the East Ocean View Breakwaters have retreated with 20 ft of the pre-fill shoreline. A portion of the shoreline has eroded past the original pre-fill position at four locations. The first location is at Station 331+43 immediately downdrift of the Bay Oaks breakwaters. This location has retreated an additional 10 ft

from the previous survey. The second location is at Station 347+63 and has eroded beyond the pre-fill shoreline during the most recent survey. The third location is at Stations 351+23, which have been consistently eroding over the past year. The fourth location is at Station 362+03 and 363+83. These two stations eroded beyond the pre-fill shoreline during the most recent survey. Station 353+03 was previously located beyond the pre-fill shoreline; however, has accreted beyond the pre-fill shoreline over the past survey. It will be important to monitor this portion of shoreline for planning purposes of future nourishment projects.



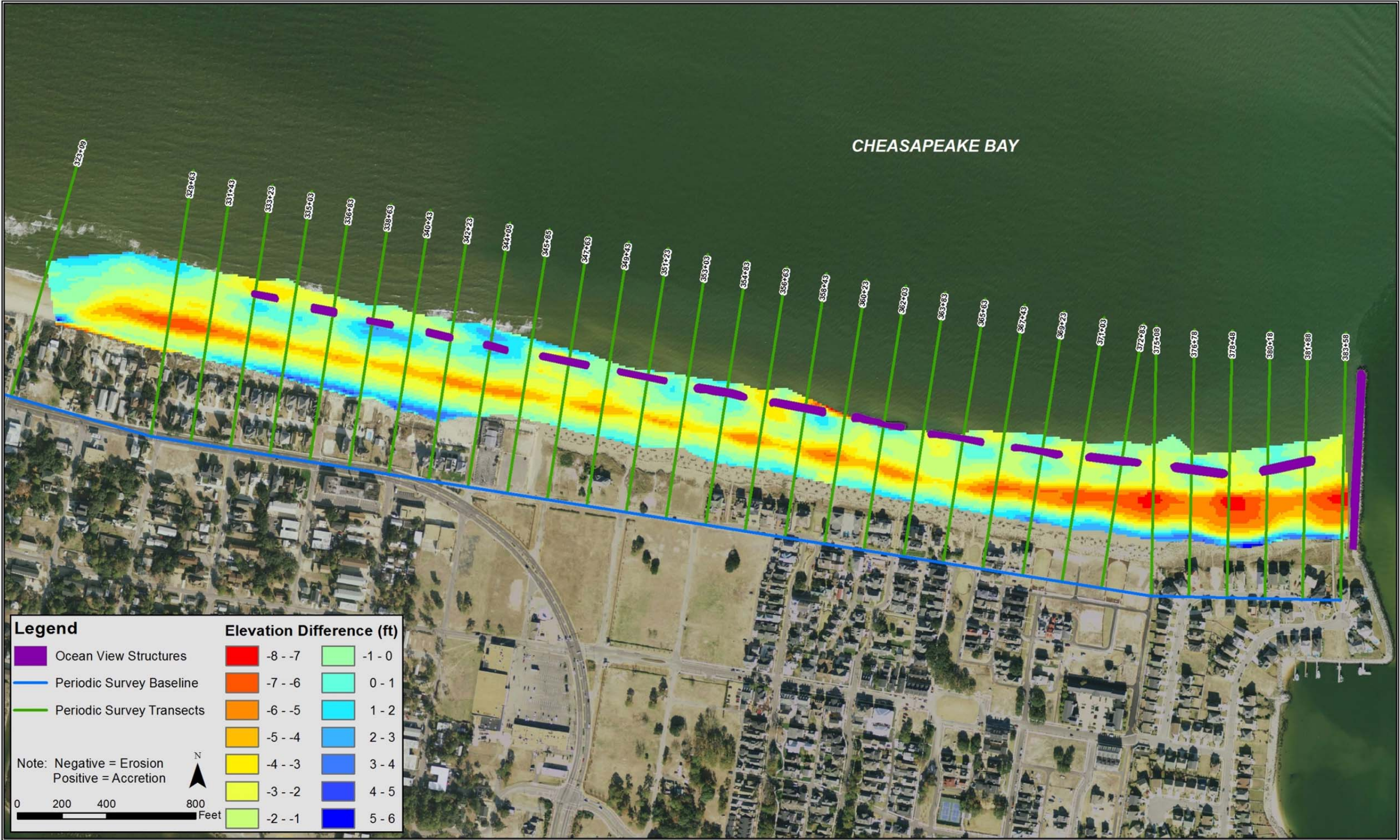
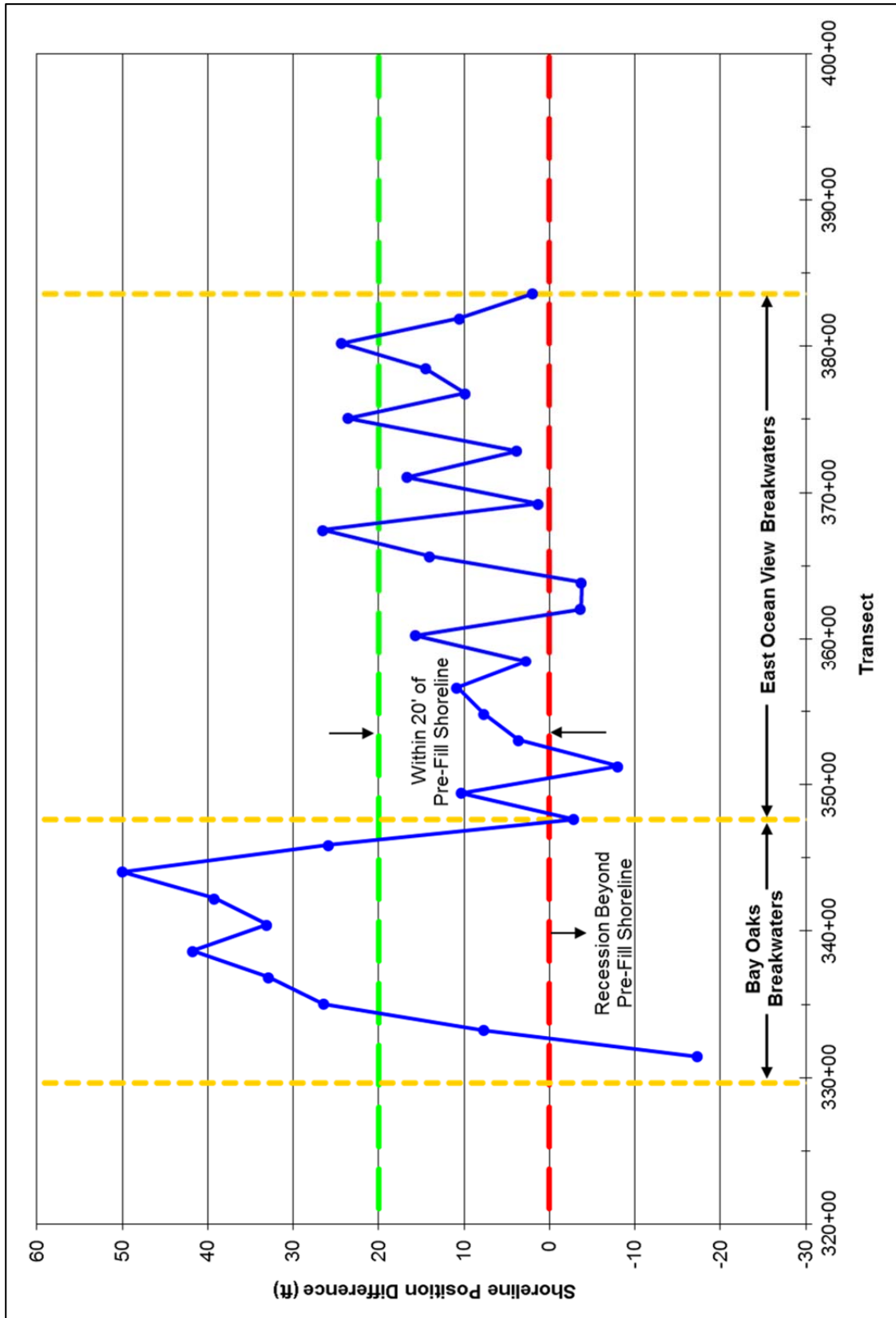


Figure 5-7: Net Volume Change Since the East Ocean View Nourishment Project (March 2009)





**Figure 5-8: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and October 2013 Shorelines for East Ocean View**

## 5.6. Central Ocean View Dune Restoration Project (2005)

The most recent periodic survey, conducted in October 2013, was also compared to the post-fill survey taken in March 2005 after completion of the Willoughby Spit to Central Ocean View Dune Restoration project. A total of 504,300 cy of sand was placed from Sta 15+00 to Sta 195+63. Table 5-11 presents the shoreline and volume change statistics comparing the two surveys.

**Table 5-11: Regional and Overall Shoreline and Volume Change Statistics for Central Ocean View Nourishment Project (March 2005 Post-Fill – October 2013 Comparison)**

Region		Average Shoreline Change (ft)	Average Volume Change Above 0 ft NAVD88 (cy/ft)	Cumulative Volume Change Above 0 ft NAVD88 (cy)	Average Volume Change Above -15 ft NAVD88 (cy/ft)	Cumulative Volume Change Above -15 ft NAVD88 (cy)
Willoughby Spit (0+00 to 45+00)	Rate per Year	-0.25	-1.22	-3,722	-0.77	-2,259
	Total	-2.15	-10.45	-31,999	-6.59	-19,424
800 Block Breakwaters (45+25 to 87+62)	Rate per Year	-5.66	-1.27	-5,598	-1.76	-7,775
	Total	-48.63	-10.94	-48,130	-15.17	-66,846
West Ocean View (93+41 to 163+49)	Rate per Year	-4.39	-1.99	-15,505	-1.41	-10,865
	Total	-37.74	-17.07	-133,298	-12.15	-93,410
Central Ocean View Breakwaters (169+63 to 195+63)	Rate per Year	-1.62	-0.32	-900	0.70	2,694
	Total	-16.97	-2.75	-7,739	6.01	23,157
OVERALL		Weighted Average	Total	Weighted Average	Total	Weighted Average
Rate per Year		-3.49	-1.38	-25,728	-1.00	-18,206
Total		-30.02	-11.83	-221,166	-8.59	-156,523

It is important to consider changes above the 0 feet contour since the project was primarily a dune restoration, placing the majority of sand above the intertidal zone. Table 5-11 shows that there has been significant loss of material in the dune system and subaerial beach above 0 feet NAVD88 since the project was completed. Roughly 221,200 cy of material has been lost above 0 feet NAVD88, or approximately 69% of the 320,700 cy originally placed above 0 feet NAVD88.

Figure 5-9 shows areas of elevation change between the post-fill survey and the October 2013 survey. As depicted in the figure, there has been erosion of the beach face and nearshore between the Willoughby Spit breakwaters, the 800 Block breakwaters, and the Central Ocean View breakwaters. These losses are less in the Central Ocean View breakwaters than in the 800 Block breakwaters and Willoughby Spit breakwaters. The losses due to the end effects from the 800 Block breakwaters can also be seen between stations 42+50 and 47+30. In West Ocean View between stations 129+17 and 141+98 there continues to be a hotspot due to the seawall at this location.

In addition, the October 2013 MHW shoreline was compared to the pre-fill MHW shoreline as another way to measure the amount of protection still being supplied by the January-March 2005 nourishment (dune restoration) project. The design life of the nourishment project was outlined in the M&N Willoughby Spit to Central Ocean View Dune Restoration Project Performance Analysis from October 2004. The study anticipated a project design life of 5 to 6 years with no major storm

activity and 2 to 3 years at hot spot areas if there were impacts to this reach of shoreline from storms. The nourishment project is in its eighth year and has been impacted by several storms since its construction, e.g. October 2006 and November 2009 nor'easters, and Hurricane Irene in August 2011. Areas where the current shoreline is within 20 feet of the pre-fill shoreline need to be targeted for nourishment. Figure 5-10 shows the MHW shoreline position difference between the pre-fill and April 2013 shorelines. As can be seen, the October 2013 Willoughby Spit to Central Ocean View MHW shoreline comes within 20 feet of the pre-fill shoreline in many locations and has even receded past the pre-fill shoreline at several locations. Areas of concern include the shoreline to the west of the 800 Block breakwater field as well as portions of the breakwater field itself which exist at stations 45+25 through 49+35 and 53+46 through 57+57. The breakwaters are most likely inhibiting the transport of sand to the western portion of the field and shoreline beyond. Due to the most recent nourishment along the eastern section of Willoughby Spit, the MHW shoreline between stations 35+00 and 45+00, which was of concern during the previous survey period, is now greater than 20 feet from the pre-fill shoreline. The West Ocean View shoreline remains an area of concern with a majority of transects showing recession either beyond the pre-fill shoreline or within 20 feet of the pre-fill shoreline. The condition of the shoreline should improve upon the completion of the West Ocean View shoreline improvement project. The location of most concern is between stations 120+93 to 141+98 which has the largest recession beyond the pre-fill shoreline due to the timber bulkhead in this location. The timber groin in this location is being reconstructed as a rock groin and 35,000 cy of sand will be placed on both sides of the groin, which should rectify this situation. The shoreline suffered significant impacts from the November 2009 nor'easter which were further exacerbated by Hurricane Irene in August 2011. The West Ocean View Shoreline Improvement Project is currently under construction. The timber groin removal, and groin rehabilitation has been completed at the time of survey. The nourishment portion of the project has yet to begin. Targeted nourishment projects should continue to be planned for these areas in the future.



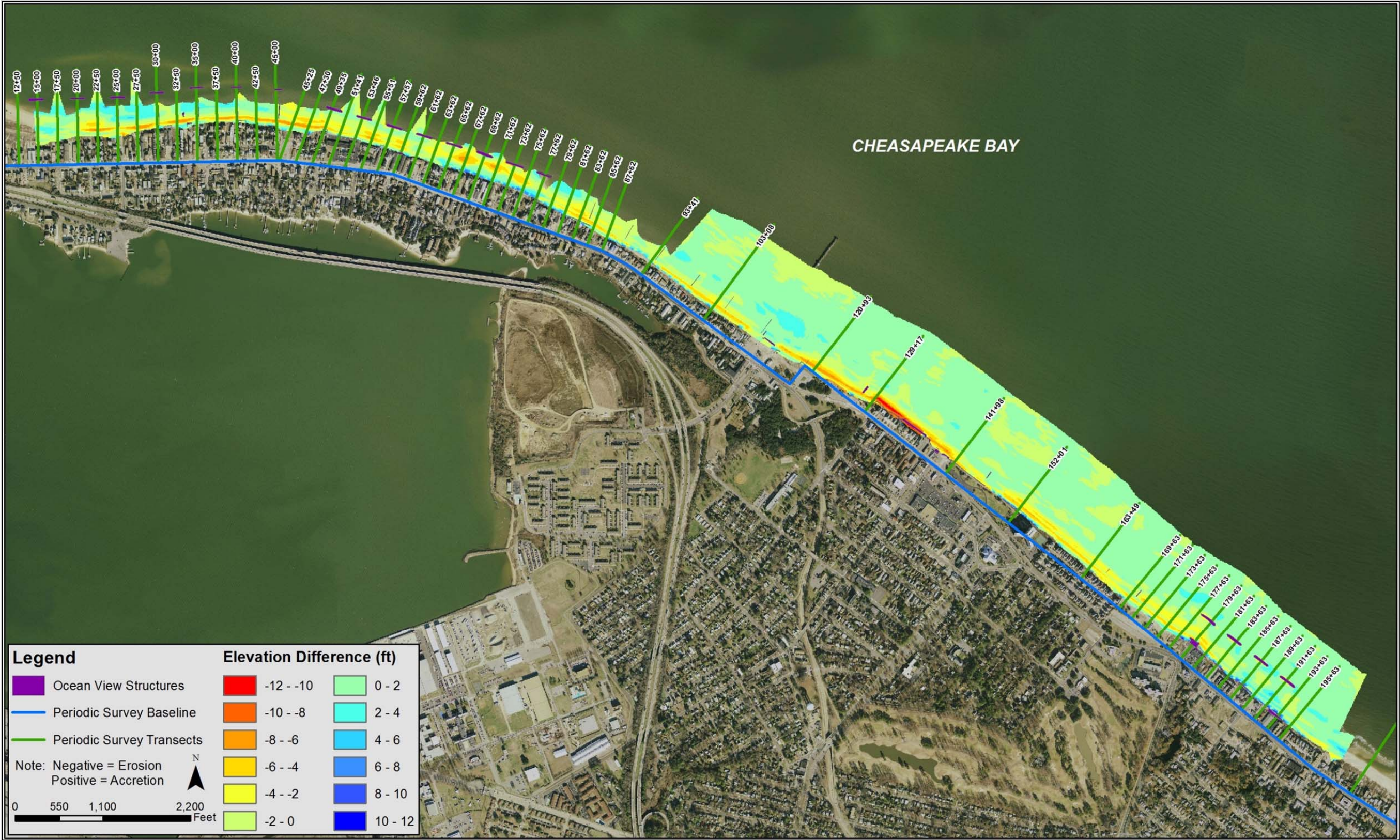
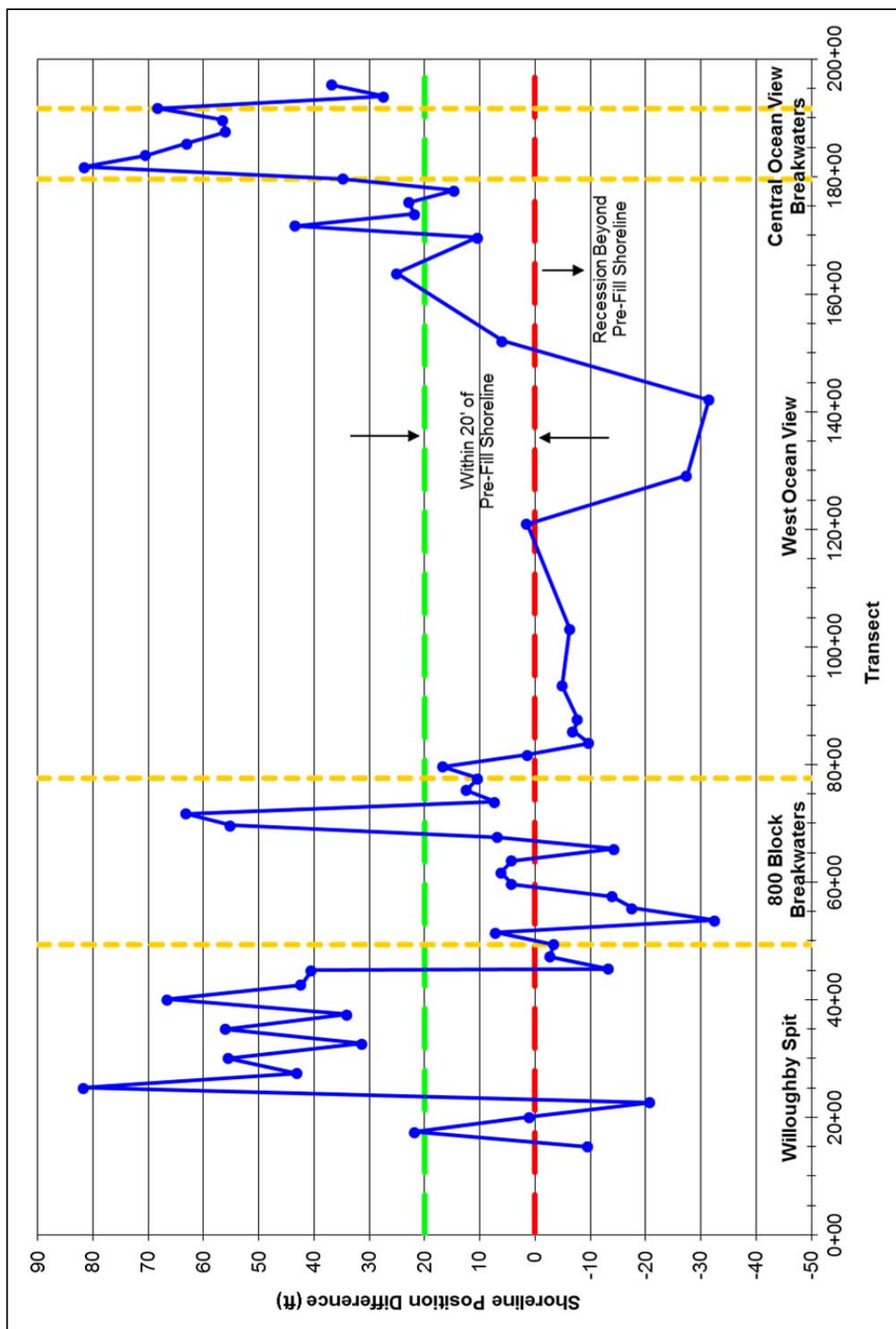


Figure 5-9: Net Volume Change Since the Willoughby Spit to Central Ocean View Dune Restoration Project (March 2005)





**Figure 5-10: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and October 2013 Shorelines for Central Ocean View**



## 6. Summary

Comprehensive periodic surveying of the entire Ocean View shoreline began with an initial survey in September 2005. The most recent survey was completed in October 2013. Subsequent surveys are planned to be conducted and evaluated every six months, in March/April and September/October. The beach and bathymetric surveys, performed by Geodynamics, utilized baseline and transect positions established in September 2005 which are used for all periodic surveys. For this periodic evaluation, the October 2013 survey was compared with both the April 2013 and September 2012 surveys. The surveys were used to compute shoreline change at MHW and volume change above 0 feet NAVD88 and above -15 feet NAVD88.

In addition, the most recent survey in October 2013 was compared to pre- and post-fill surveys taken after the East Ocean View beach nourishment and Willoughby Spit to Central Ocean View dune restoration projects in March 2009 and January-March 2005 respectively. This was done to quantify the amount of material loss since the projects were completed and condition of the shoreline with respect to pre-fill conditions.

Key statistics were computed for defined regions along Ocean View and the entire shoreline for the time period between both the September 2012 and October 2013 surveys and the April 2013 and October 2013 surveys.

Comparison	Parameter	Quantity
September 2012 vs. October 2013	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-7.05 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	-37,133 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	63,140 cy/yr
April 2013 vs. October 2013	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-2.69 ft
	Cumulative Volume Change Above 0 ft NAVD88	-35,890 cy
	Cumulative Volume Change Above -15 ft NAVD88	-85,217 cy

The average shoreline change rate for the entire shoreline at MHW between the September 2012 and October 2013 surveys was -7.05 ft/yr, and the cumulative volume change above 0 feet NAVD88 was approximately -37,133 cy/yr. This indicates an overall volumetric loss in the dune and subaerial beach over the past year. The overall gain above -15 feet NAVD88 of 63,140 cy/yr indicates that while there were losses on the dune and subaerial beach, there was sediment gain across the nearshore system. The most recent period of comparison, from the April 2013 survey to the October 2013 survey depicts an overall loss at the MHW line of -2.69 ft. The cumulative volume change above 0 ft NAVD88 indicates a sediment loss to the subaerial beach of -35,890 cy, which accounts for the majority of the loss throughout the entire year. There was also a loss of sediment in the nearshore system above -15 feet NAVD88 of -85,217 cy. This can be attributed primarily to the equilibration of the Willoughby Spit Shoreline Improvement Project as well as the lack of sediment source in East Ocean View due to the Little Creek Inlet Jetty.

### Willoughby Spit

The Willoughby Spit region is still feeling the effects from the equilibration of the Willoughby Spit Shoreline Improvement Project, which finished construction in December 2013. The most significant gains over the year occurred in the eastern end of the Willoughby Spit reach due to a beach nourishment. The major losses in this reach were located at the vacant City land just east of the corner of Lea View Avenue and 15<sup>th</sup> View Street, as this was the sand source for the nourishment project. The Improvement project also included the construction of seven additional nearshore breakwaters, with a breakwater signature starting to become noticeable during this survey.

### 800 Block Breakwaters

In the 800 Block region, there has been a net loss of sediment above 0 feet NAVD88 and -15 feet NAVD88 and erosion of the MHW shoreline. The tombolo located at the realigned breakwater has remained detached allowing sand to transport freely through this reach.

### West Ocean View

The West Ocean View shoreline improvement project has begun during the most recent survey period. The patterns of sediment gains/losses in the West Ocean View region during the most recent period shows higher erosion rates offshore at the west end of the region. This area is closest to the Central Ocean View Breakwaters and is likely affected by these structures.

### Central Ocean View Breakwaters

The Central Ocean View Breakwaters region showed losses in the MHW shoreline position; however, gains in sediment volume over the year. The smaller gains in volume above 0 feet NAVD88 in the most recent survey period, April 2013 to October 2013, indicate that majority of the gains occurred during the winter season, which is likely due to quiescent weather.

### Central Ocean View

Typically a very stable region, Central Ocean View has experienced erosion of the MHW shoreline, with a volumetric loss above 0 feet NAVD88 and a volumetric gain above -15 feet NAVD88 over the past year. The majority of the volumetric loss above 0 feet NAVD88 occurred during the most recent survey period.

### East Ocean View

As expected, due to the direction of sediment movement, there were continued volume losses to the beach in the East Ocean View region between the September 2012 and October 2013 period. During the most recent survey period there were more significant losses above -15 feet NAVD88 compared to the overall year. The Bay Oaks breakwaters are performing well, trapping sediment and eliminating the hotspot at this location. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source. The profiles have a fairly steady pattern of accretion on the profiles behind the breakwaters and erosion on the profiles

between the breakwaters showing the influence of the breakwaters on decreasing the wave heights and retaining sediment along the shore.

In addition to regional assessments, comparison of the October survey was made against post-fill surveys from the East Ocean View beach nourishment and Willoughby Spit to Central Ocean View dune restoration which took place in March 2009 and January-March 2005 respectively.

Comparison	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above 15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
East Ocean View Nourishment vs. October 2013	-90.83 ft	-17.87 cy/ft	-93,016 cy	-29.37 cy/ft	-152,100 cy
Central Ocean View Nourishment vs. October 2013	-30.02 ft	-11.83 cy/ft	-221,166 cy	-8.59 cy/ft	-156,523 cy

The approximately 93,000 cy volumetric loss above 0 feet NAVD88 from the East Ocean View project is roughly 75% of the original amount placed in this dune and subaerial beach area while the approximately 221,200 cy loss above 0 feet NAVD88 in the Central Ocean View project area is roughly 67% of the original amount placed above 0 feet NAVD88. Due to storm impacts and background erosion that has occurred, as anticipated, over the projects' design life, there are areas in both of these shoreline regions that should be targeted for nourishment. The completed Willoughby Spit project as well as the West Ocean View project under way will help alleviate the concerns with these hot spots and provide additional protection in vulnerable areas; however, there are still other areas that may require nourishment to provide adequate storm protection. The East Ocean View project may also require a renourishment in the next 1 to 2 years.

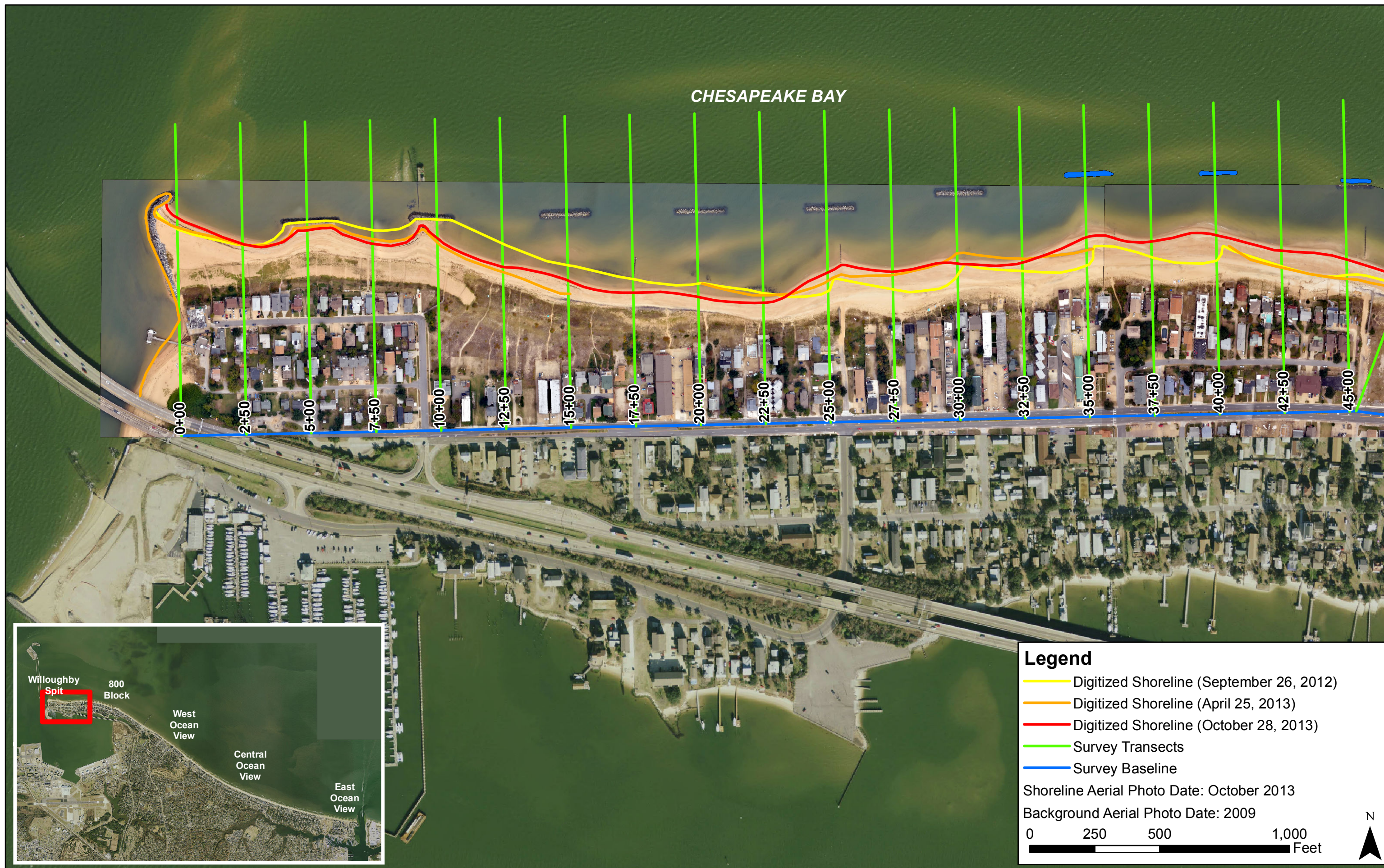
As another measure of the protection being supplied by the East Ocean View and Central Ocean View nourishment projects, the projects' pre-fill and October 2013 MHW shoreline positions were compared. Areas where the current shoreline has receded beyond or eroded within 20 ft of the pre-fill shoreline may need to be targeted for immediate nourishment. Results of this analysis indicated that the East Ocean View nourishment project has provided ample shoreline protection for the majority of the shoreline with only slight end effects immediately west of the most recently constructed breakwaters; however, the November 2009 Nor'easter and Hurricane Irene have impacted the design life and renourishment of this area may be required in the next 1 to 2 years. The Willoughby Spit to Central Ocean View shoreline continues to have various problem spots. The western portion of the shoreline in the Willoughby Spit groin field, the majority of the shoreline behind the 800 Block breakwaters and West Ocean View shoreline has eroded to within 20 ft of the pre-fill shoreline and even receded beyond the pre-fill shoreline in some locations. This project had an anticipated design life of 5 to 6 years with no storm activity with hot spot areas anticipated to require nourishment after 2 to 3 years if storm activity impacted this region. The project is at the end of the anticipated design life and has been impacted by storm activity. While the emergency dune restoration project in 2010 restored a portion of the dunes in certain areas, there are still concerns about the hot spots in the area. As the Willoughby Spit shoreline equilibrates, the areas of concern in this reach should be alleviated. The West Ocean View Shoreline Improvement Project will also help

alleviate the concerns with the hot spots within this reach and provide additional protection in vulnerable areas.

This is the seventeenth periodic survey report completed to date, and sixteenth evaluation of a consistent survey period utilizing beach and bathymetric surveys. As noted, there are inevitable margins of error associated with the survey data that may reduce the accuracy of volumetric change analyses. Therefore, it is essential to thoroughly review the beach and bathymetric profiles using various analytical techniques and general engineering judgment to assure that results are not falsely interpreted. Comparison of seasonal surveys (i.e. September 2012 to October 2013) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons are useful to assess the direct impact of extreme events which may occur during the six month period between surveys. Future periodic survey evaluations will continue to improve on analysis techniques so that the rich survey data sets are best utilized.

## **Appendix A: Aerial Photography and Digitized Shorelines**

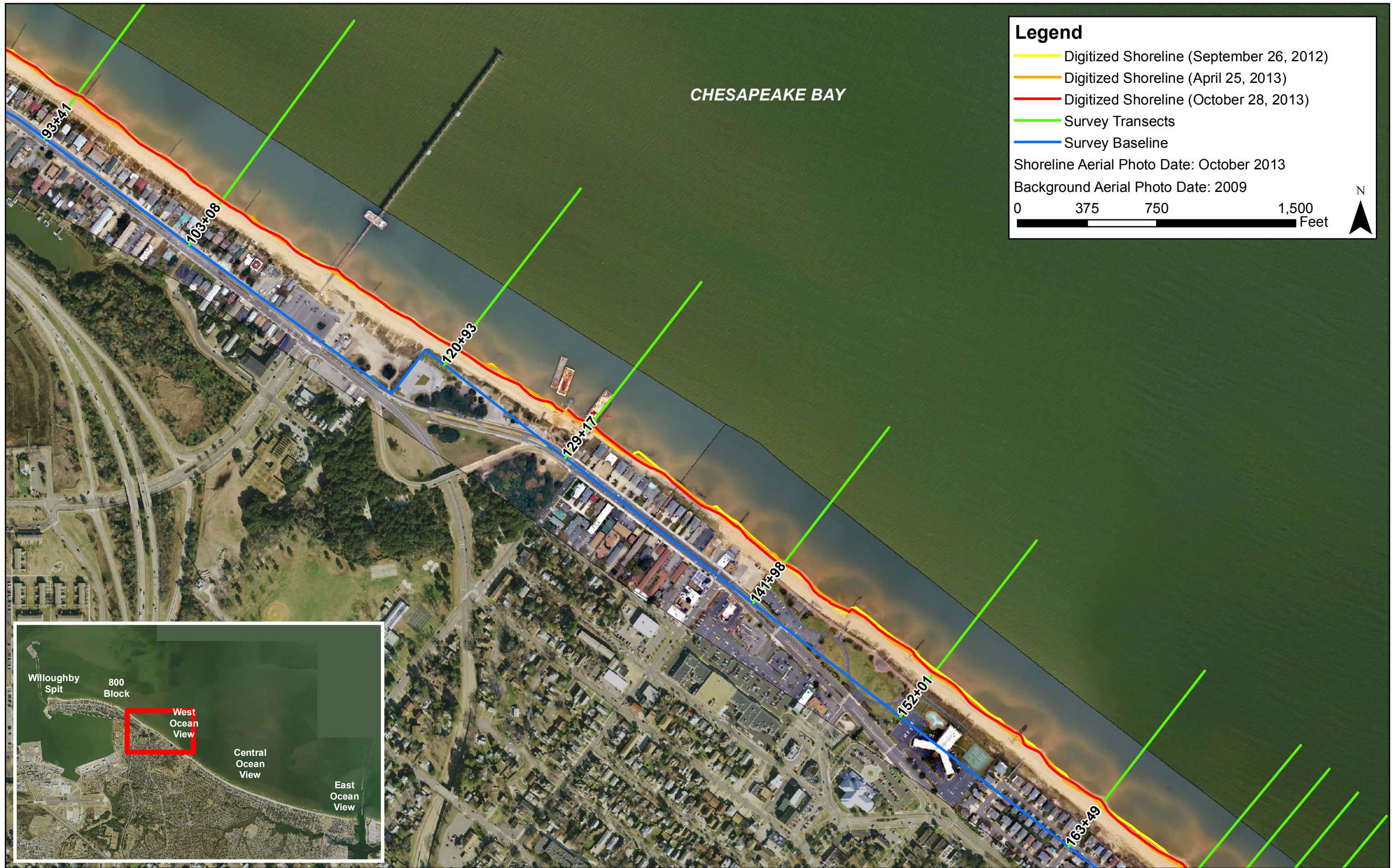




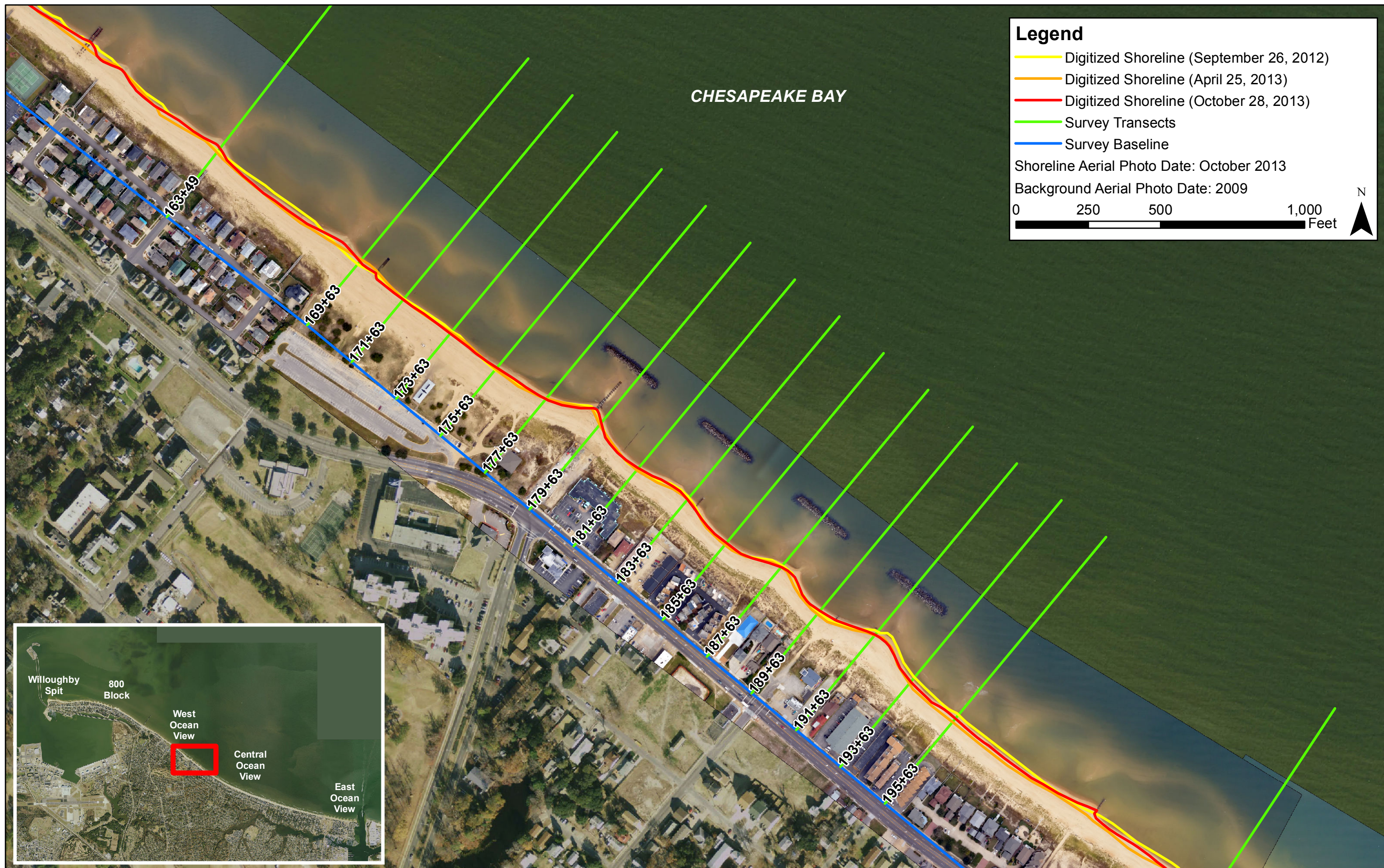




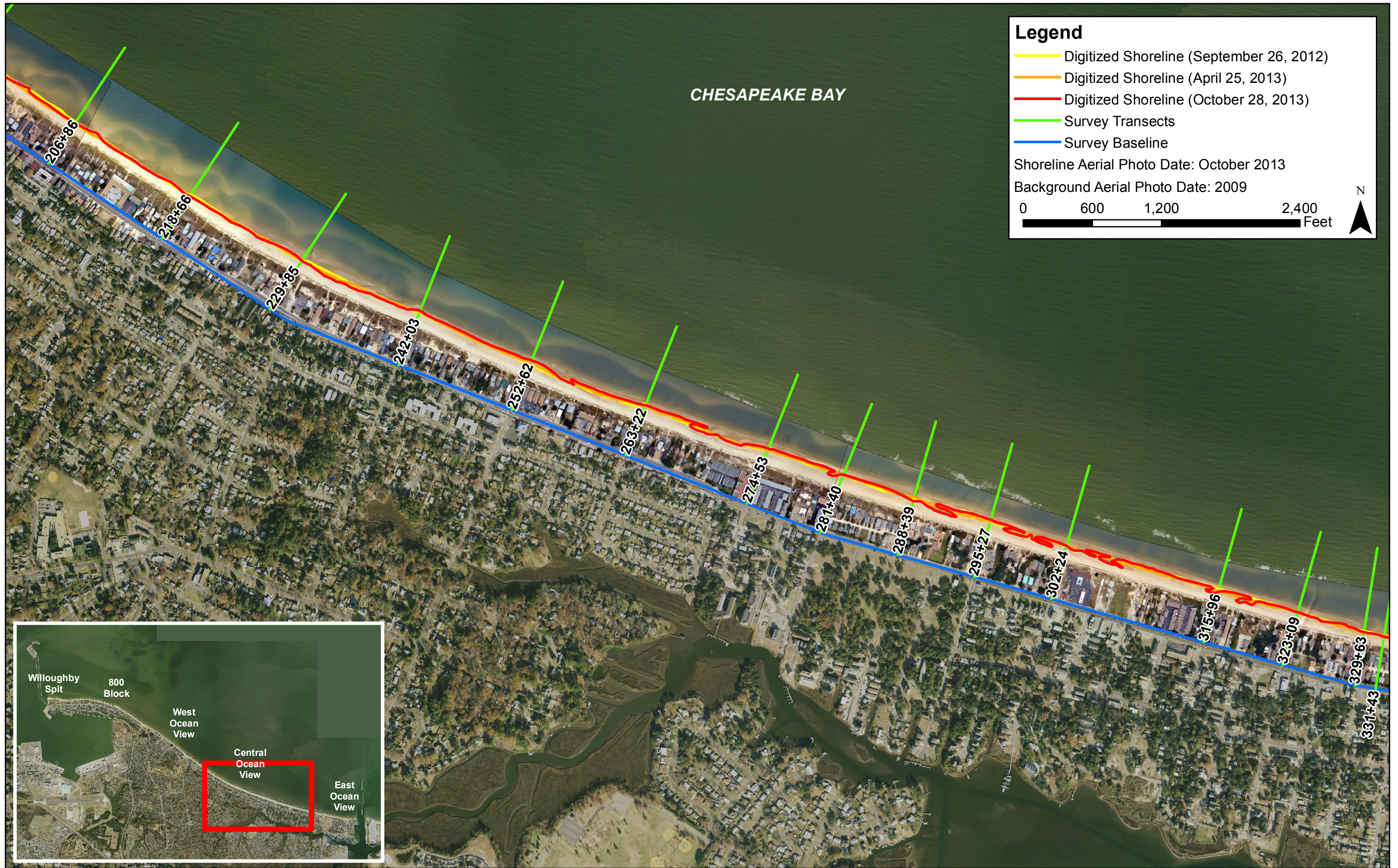




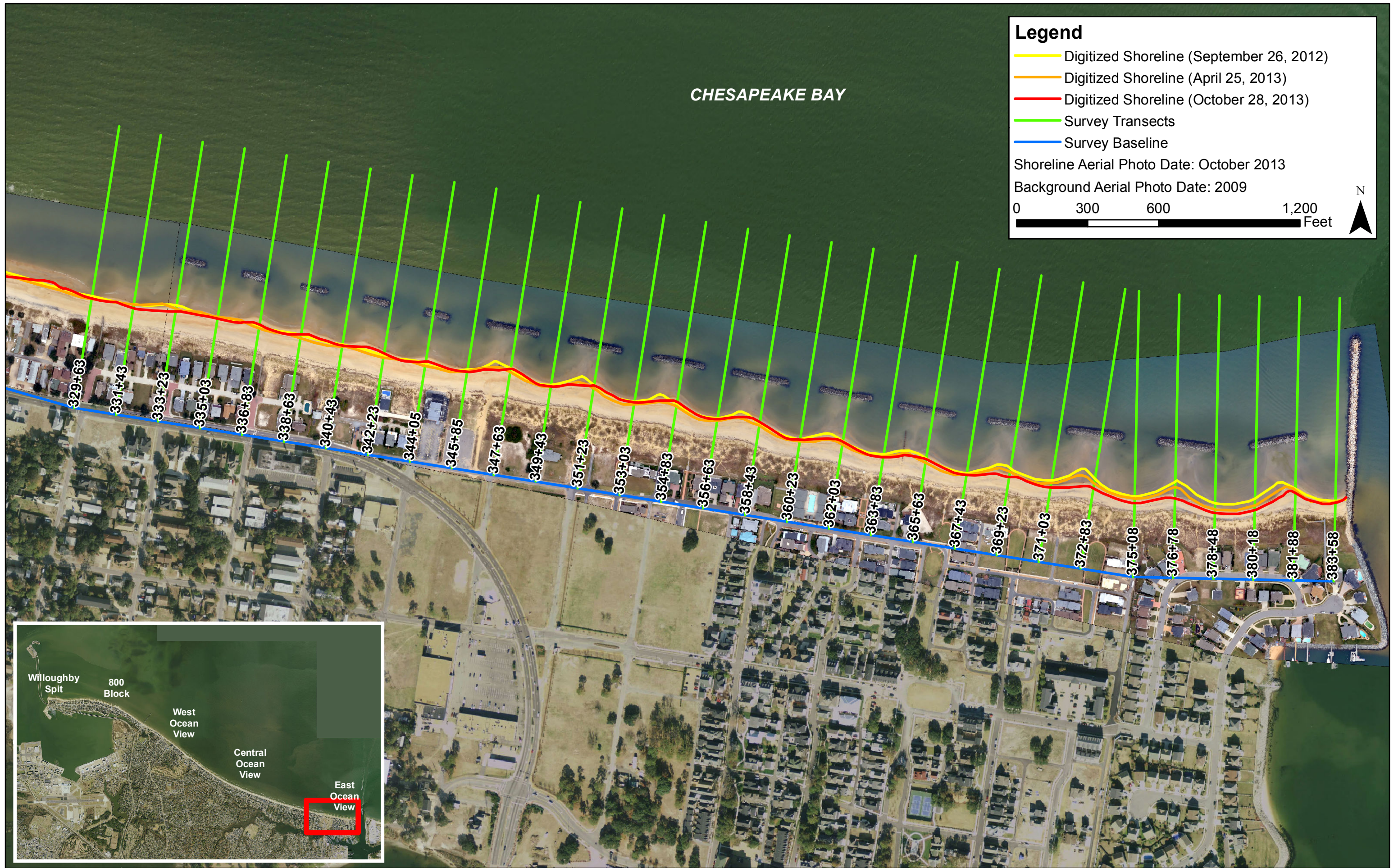






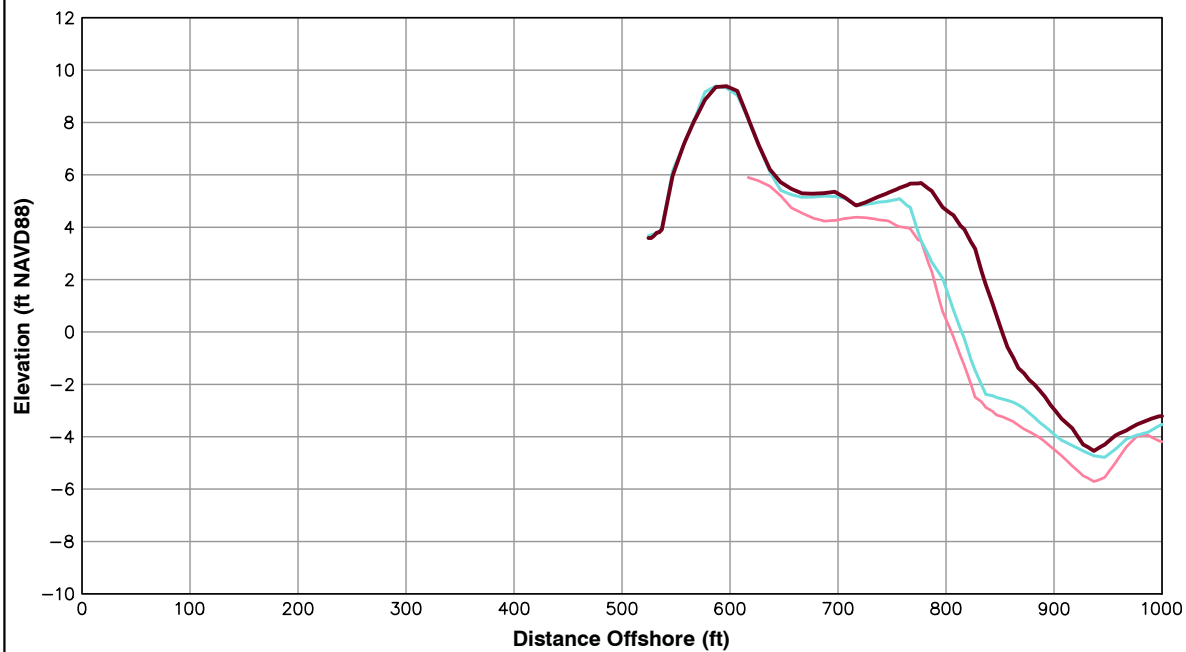
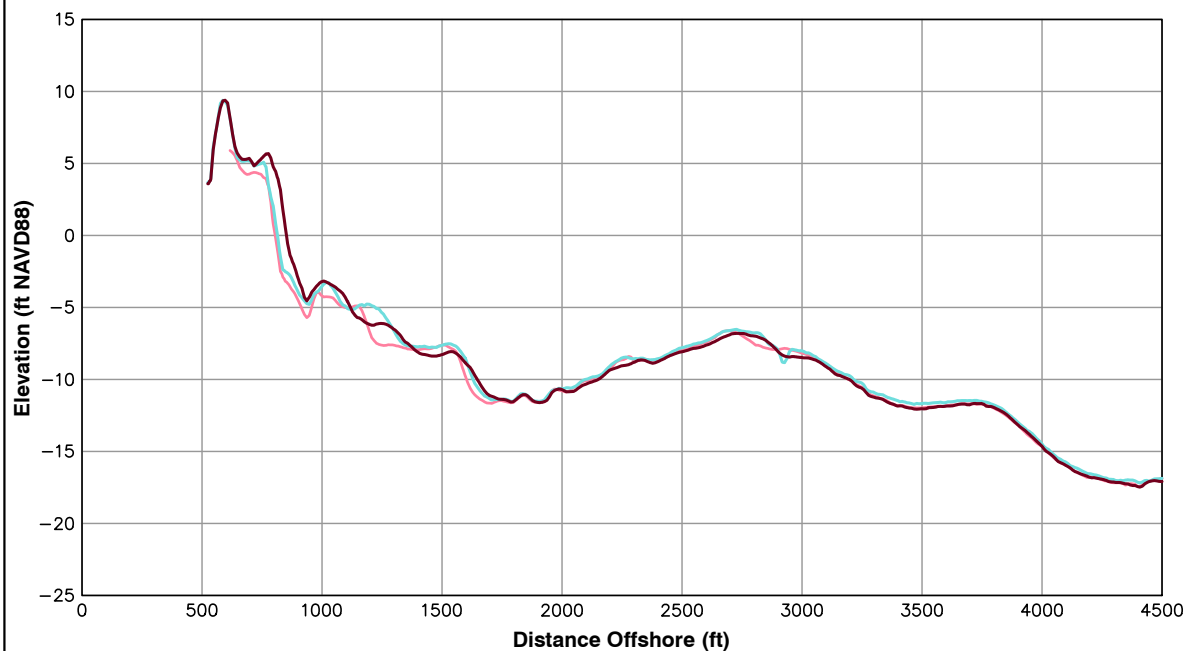








## Appendix B: Survey Comparison Plots



Survey Transect 0+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	45.70 ft/yr	38.17 ft
Volume Change Above -15 ft NAVD88	30.27 cy/ft/yr	-10.23 cy/ft
Volume Change Above 0 ft NAVD88	13.44 cy/ft/yr	8.67 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

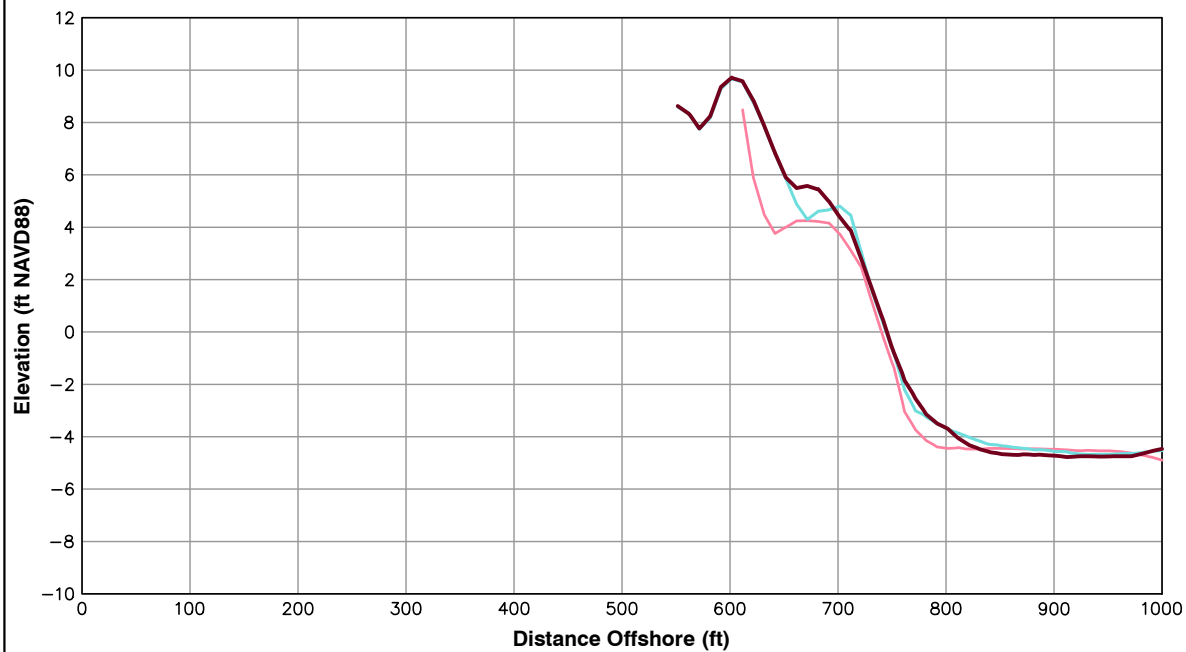
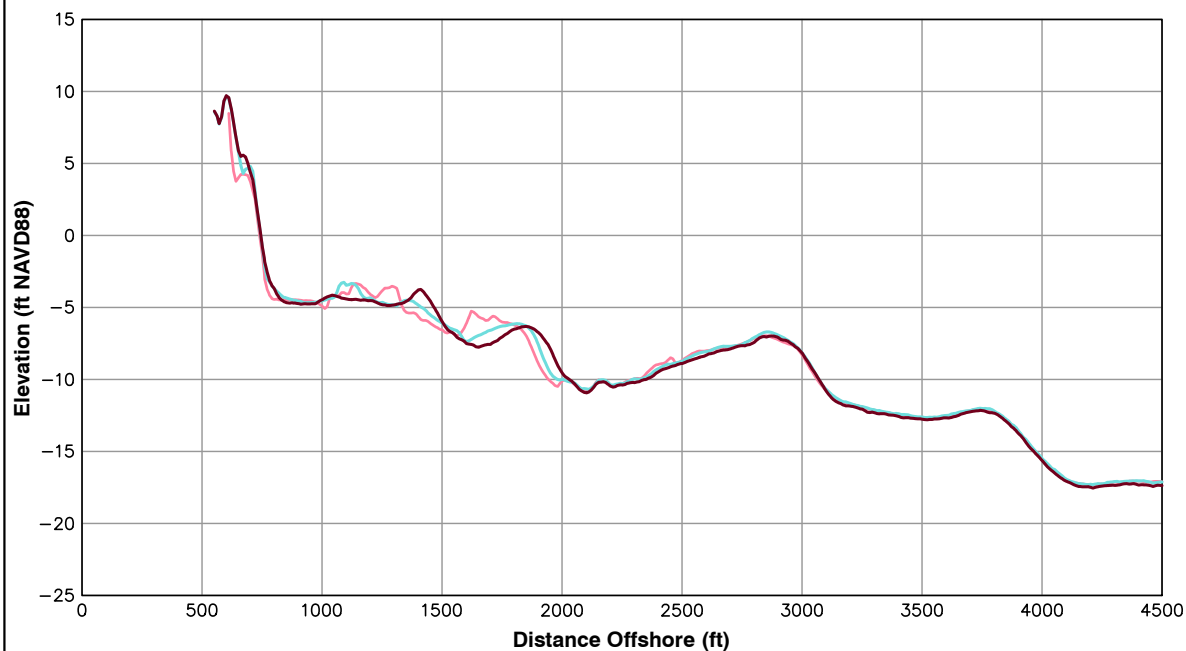


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 0+00**

**Pg 1 of 106**

**Fall 2013**



Survey Transect 2+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	4.26 ft/yr	0.88 ft
Volume Change Above -15 ft NAVD88	-0.70 cy/ft/yr	-13.00 cy/ft
Volume Change Above 0 ft NAVD88	6.69 cy/ft/yr	0.89 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



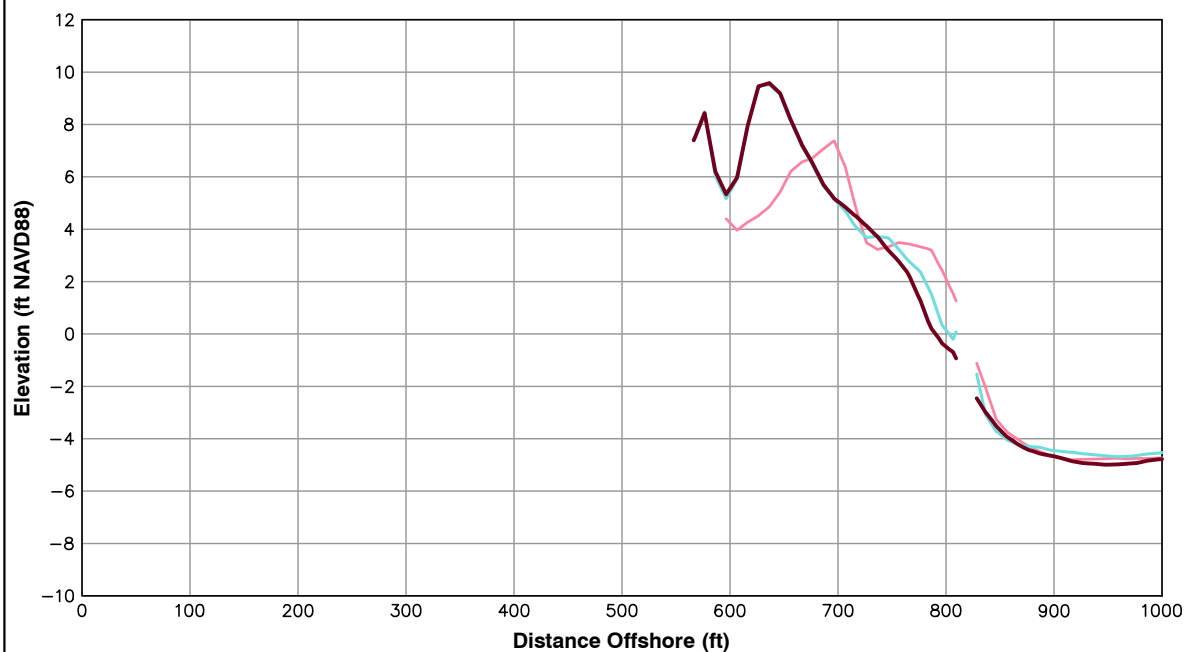
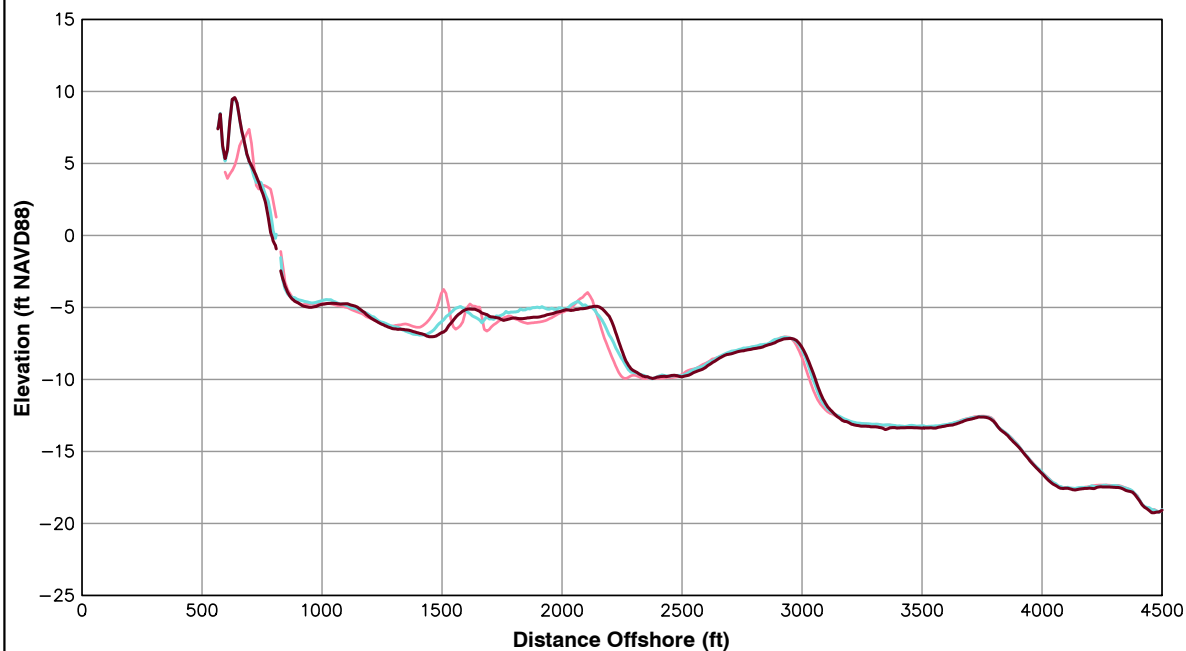
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 2+50**

**Pg 2 of 106**

**Fall 2013**





Survey Transect 5+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-31.53 ft/yr	-12.01 ft
Volume Change Above -15 ft NAVD88	3.91 cy/ft/yr	-10.69 cy/ft
Volume Change Above 0 ft NAVD88	2.40 cy/ft/yr	-0.96 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



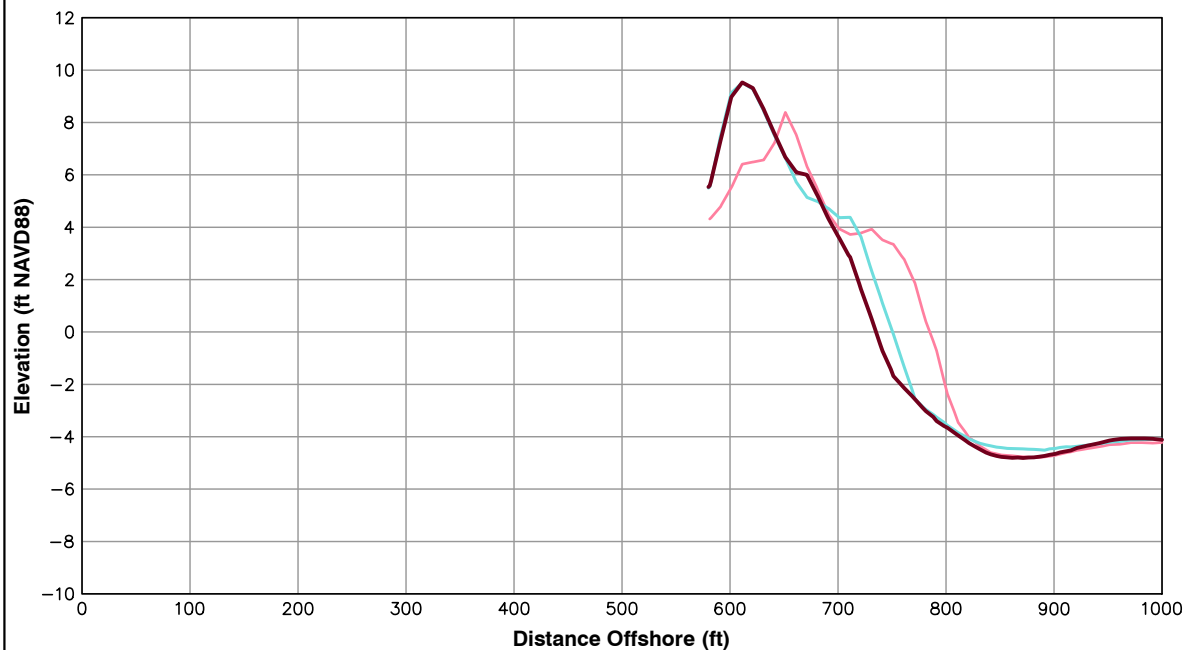
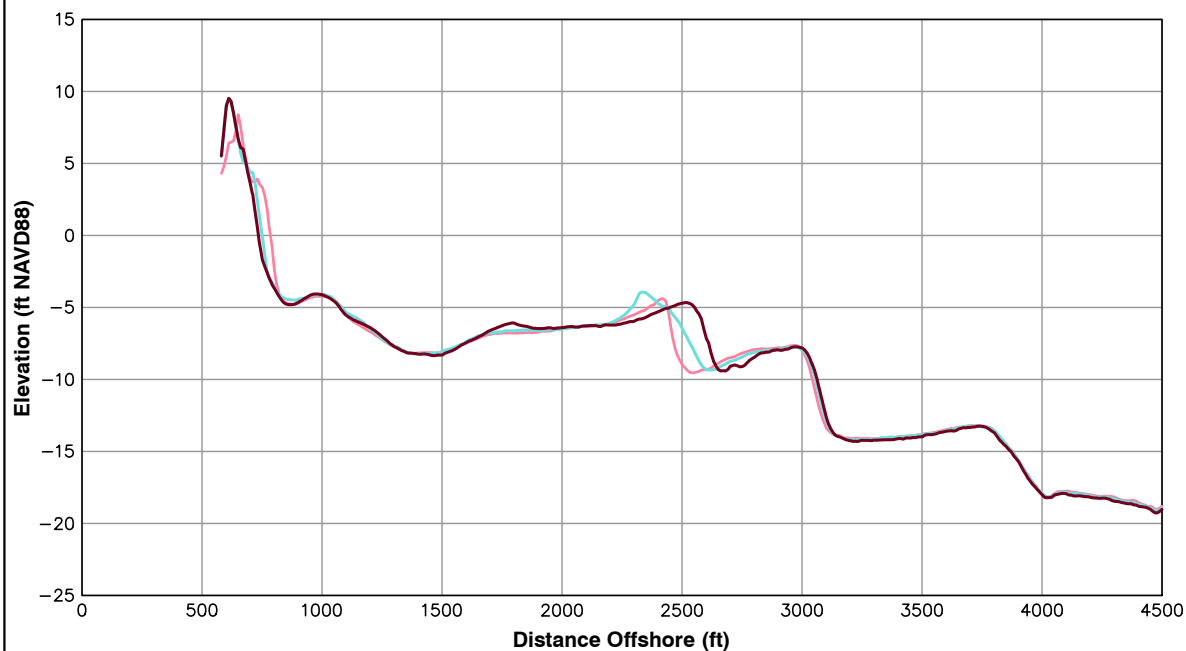
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 5+00**

**Pg 3 of 106**

**Fall 2013**



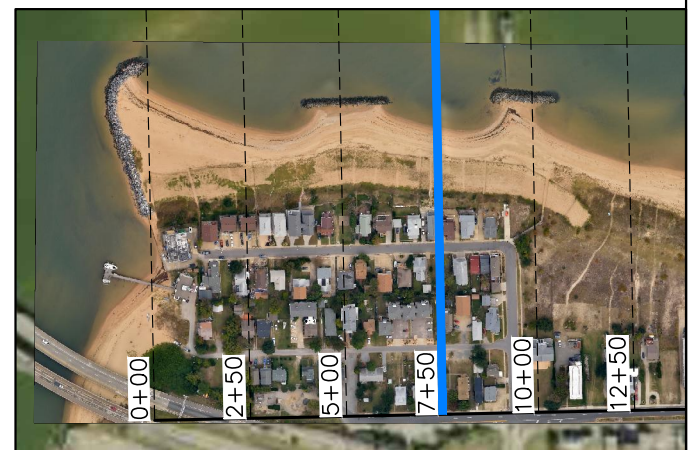
Survey Transect 7+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-47.61 ft/yr	-15.31 ft
Volume Change Above -15 ft NAVD88	9.74 cy/ft/yr	-1.56 cy/ft
Volume Change Above 0 ft NAVD88	-2.73 cy/ft/yr	-2.37 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



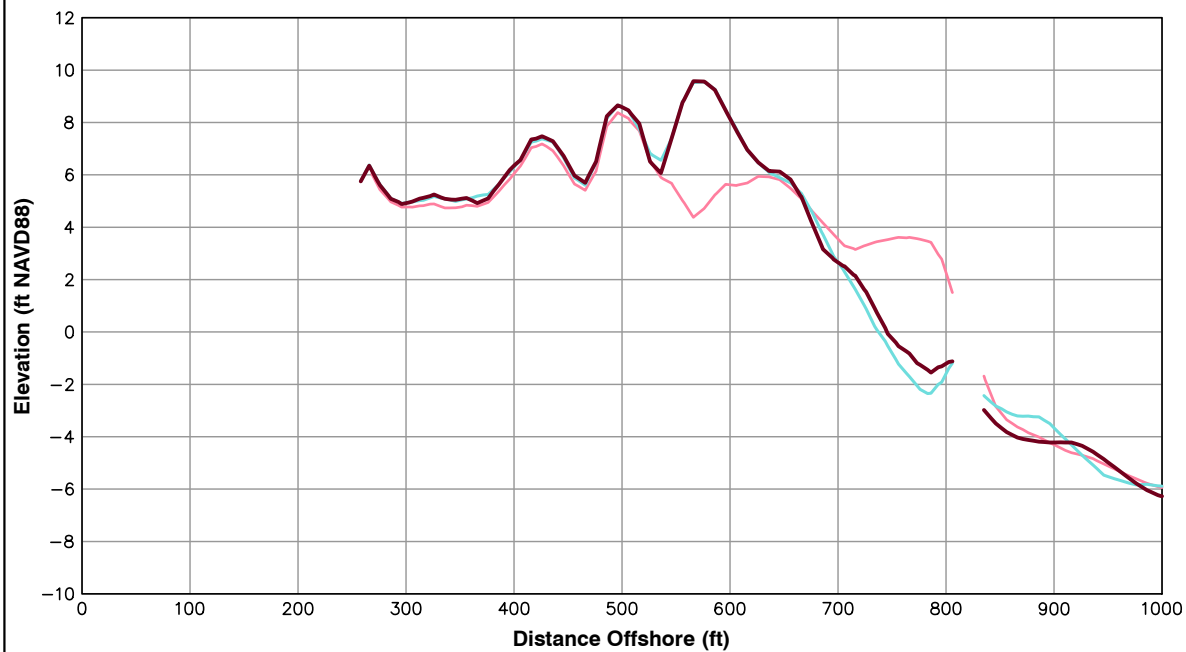
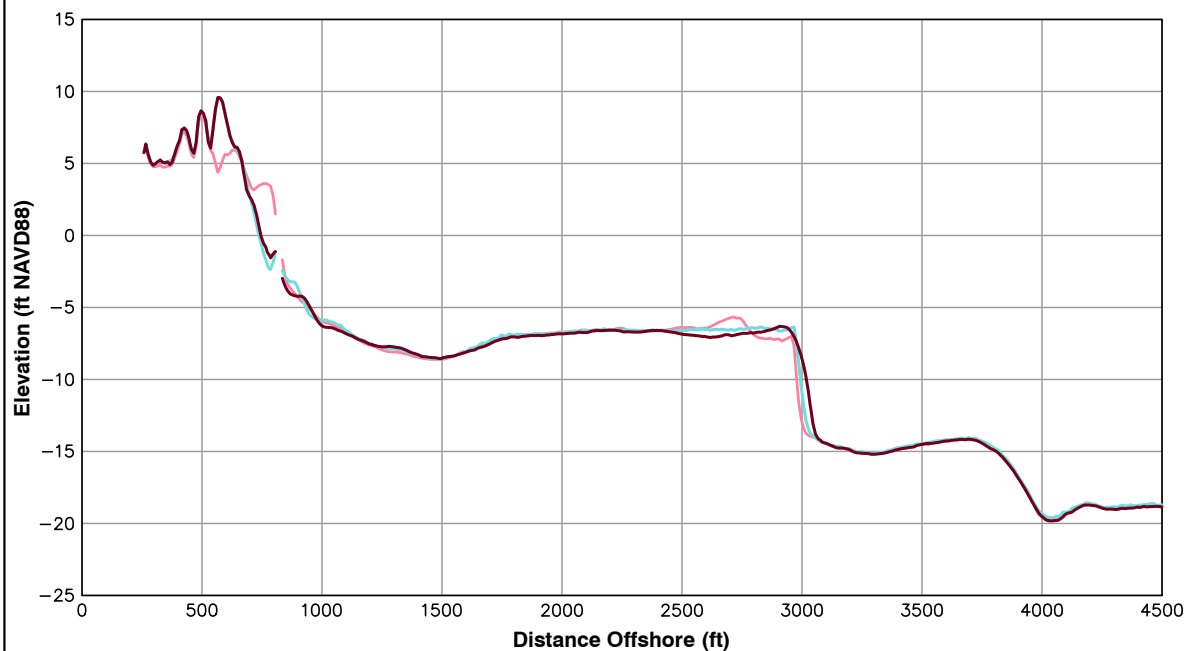
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 7+50**

**Pg 4 of 106**

**Fall 2013**





Survey Transect 10+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-73.57 ft/yr	8.24 ft
Volume Change Above -15 ft NAVD88	0.85 cy/ft/yr	-5.44 cy/ft
Volume Change Above 0 ft NAVD88	1.49 cy/ft/yr	0.38 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

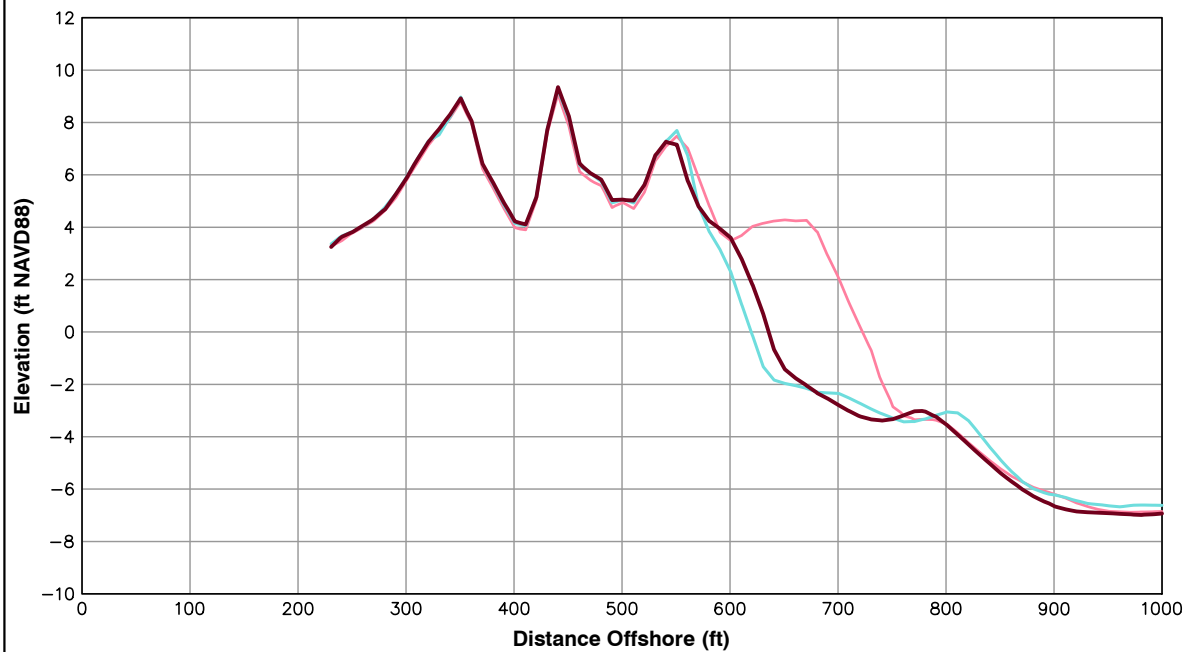
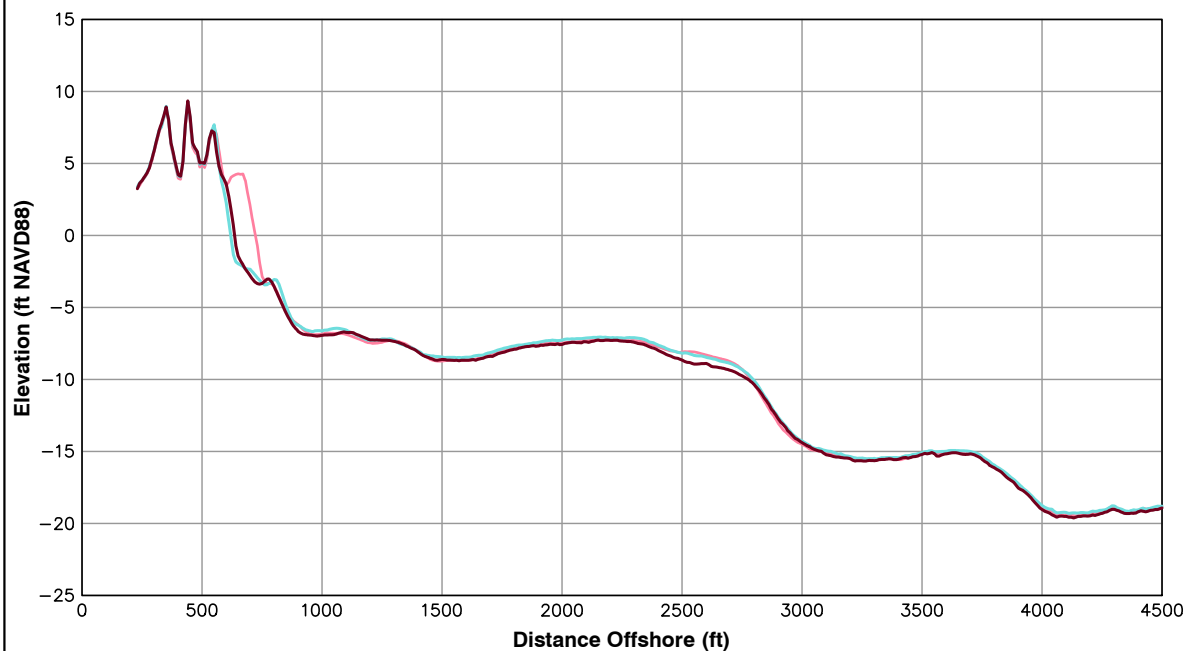


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 10+00**

**Pg 5 of 106**

**Fall 2013**



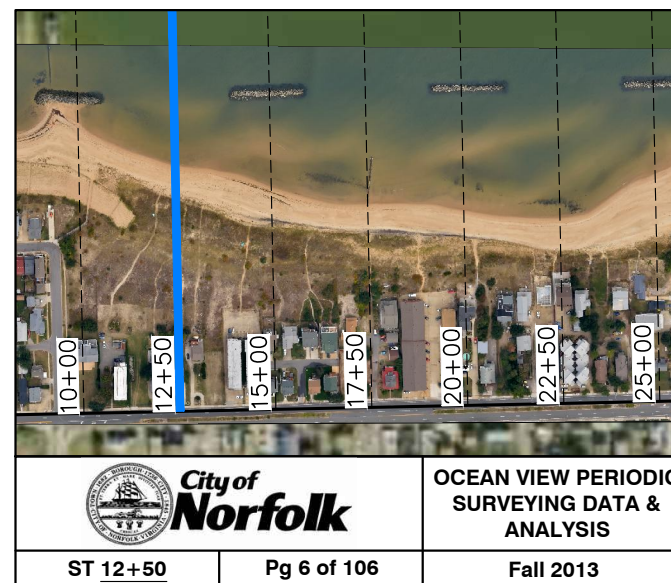
Survey Transect 12+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-79.01 ft/yr	16.81 ft
Volume Change Above -15 ft NAVD88	-27.52 cy/ft/yr	-19.20 cy/ft
Volume Change Above 0 ft NAVD88	-10.97 cy/ft/yr	2.18 cy/ft

**LEGEND:**

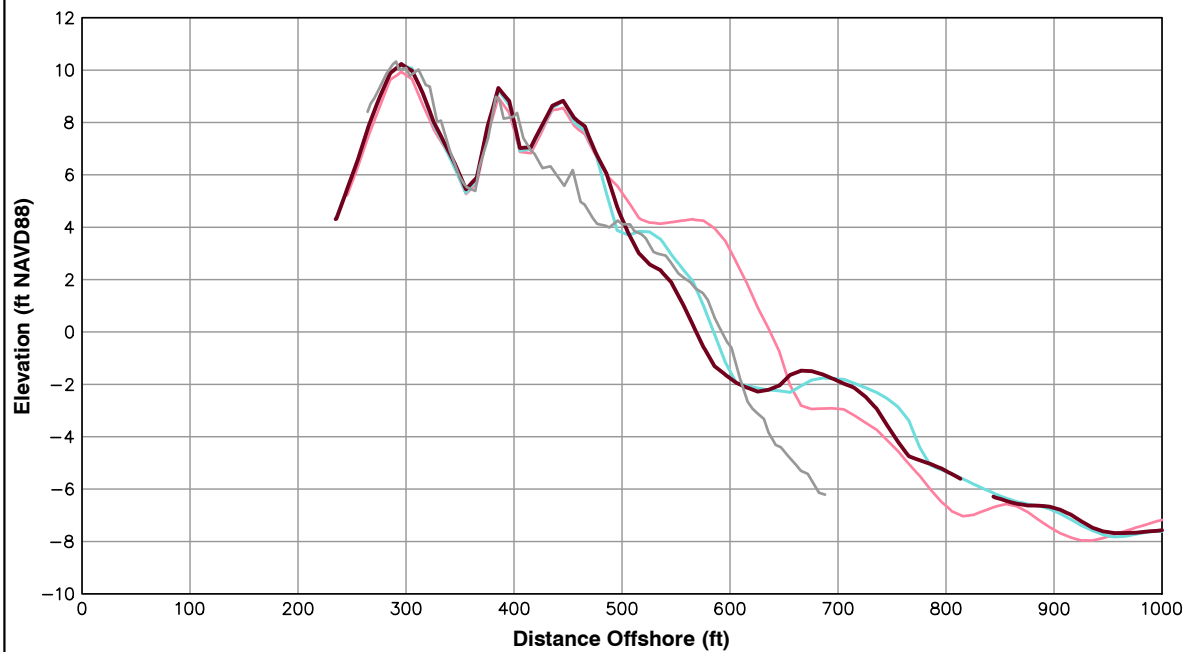
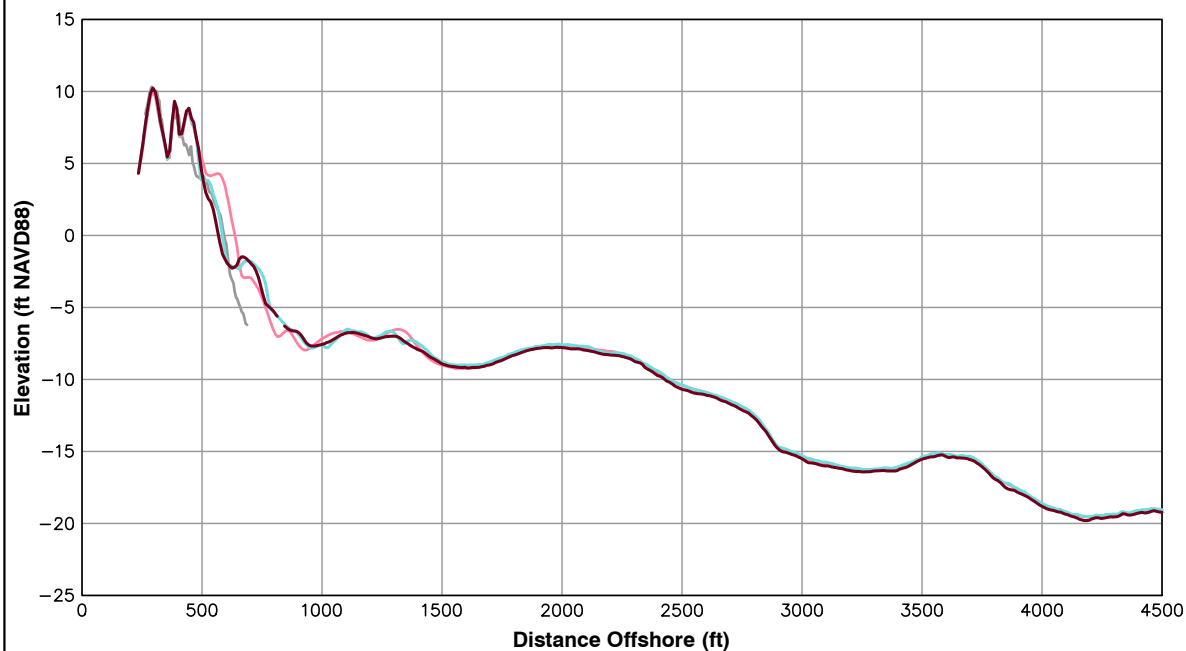
2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.







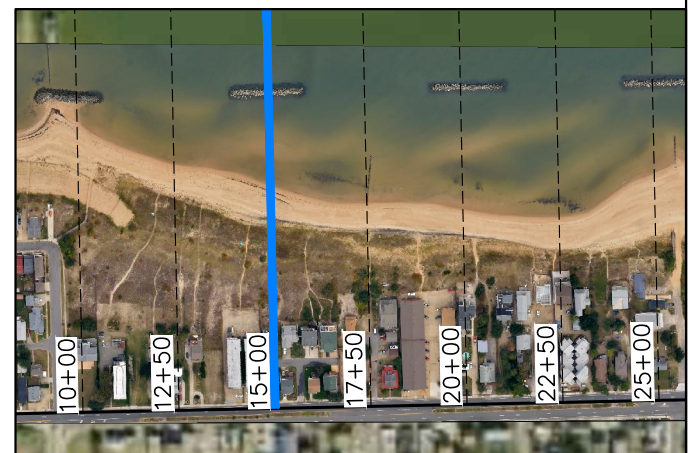
Survey Transect 15+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-64.07 ft/yr	-18.29 ft
Volume Change Above -15 ft NAVD88	-15.79 cy/ft/yr	-16.46 cy/ft
Volume Change Above 0 ft NAVD88	-9.51 cy/ft/yr	-1.88 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

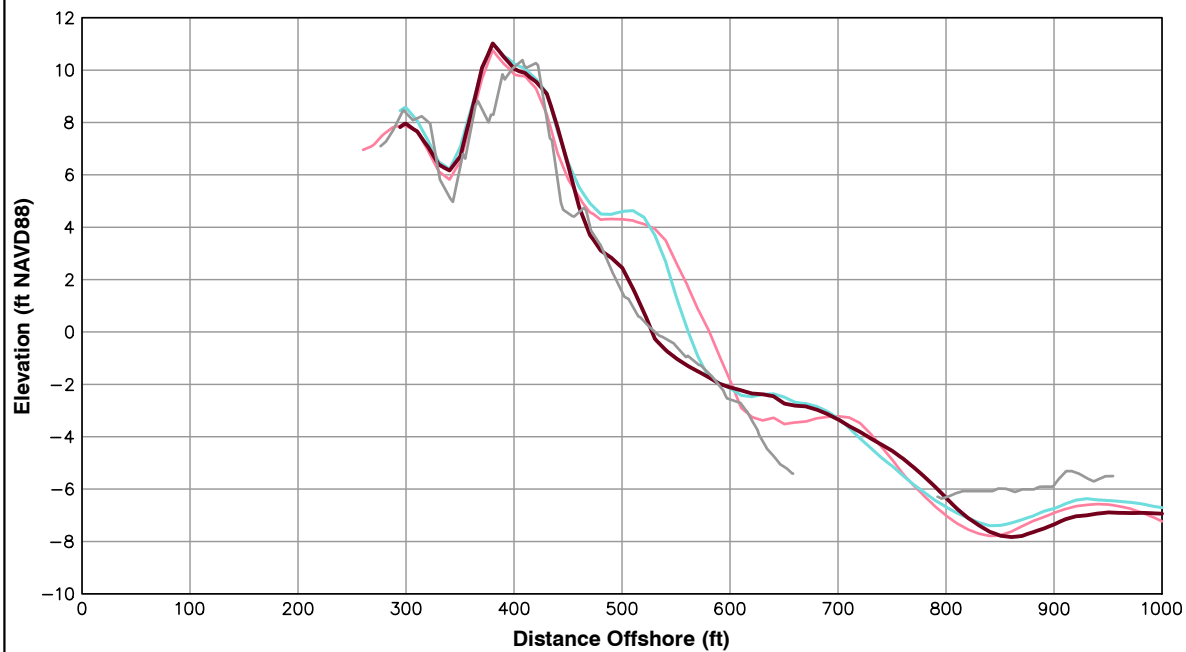
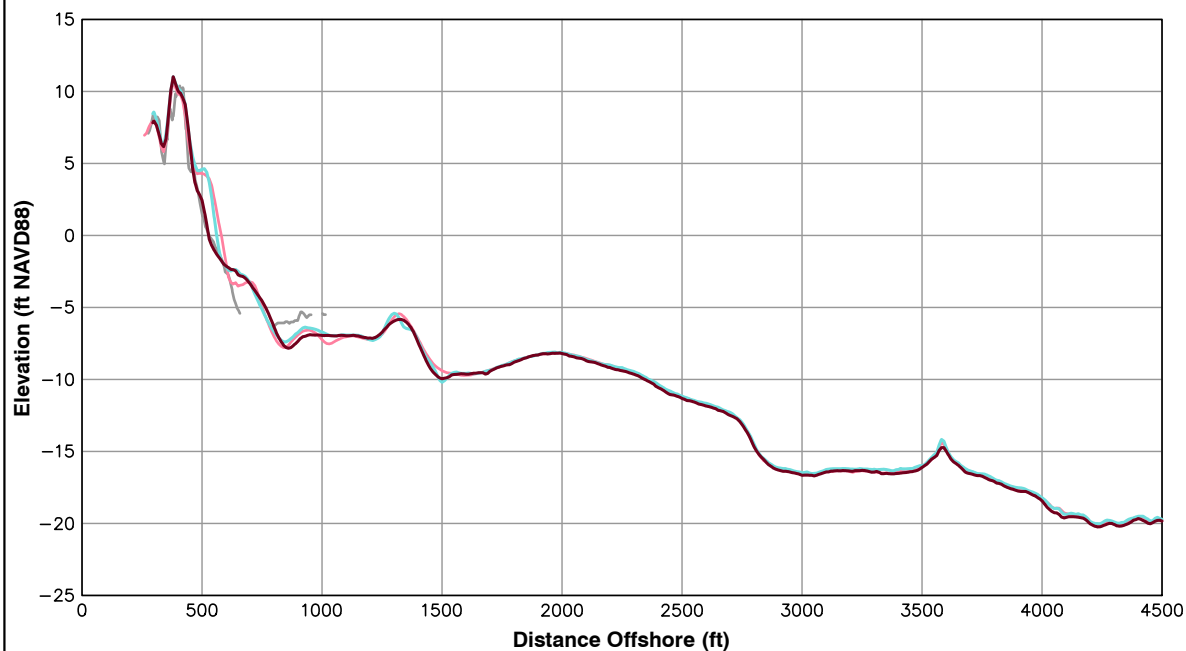


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 15+00**

**Pg 7 of 106**

**Fall 2013**



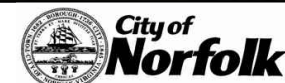
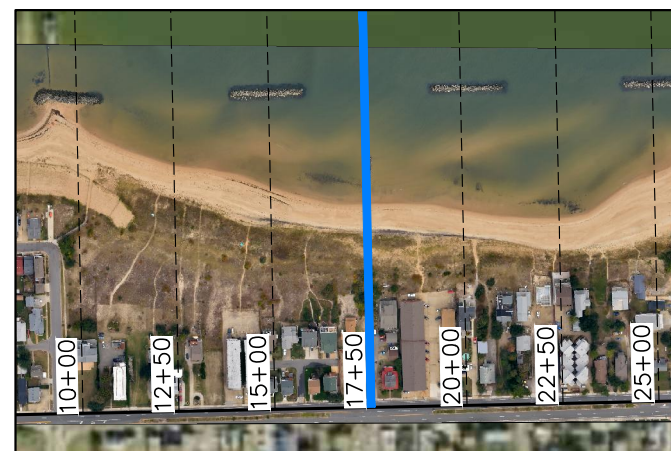
Survey Transect 17+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-48.53 ft/yr	-35.51 ft
Volume Change Above -15 ft NAVD88	-11.88 cy/ft/yr	-18.61 cy/ft
Volume Change Above 0 ft NAVD88	-6.85 cy/ft/yr	-8.96 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



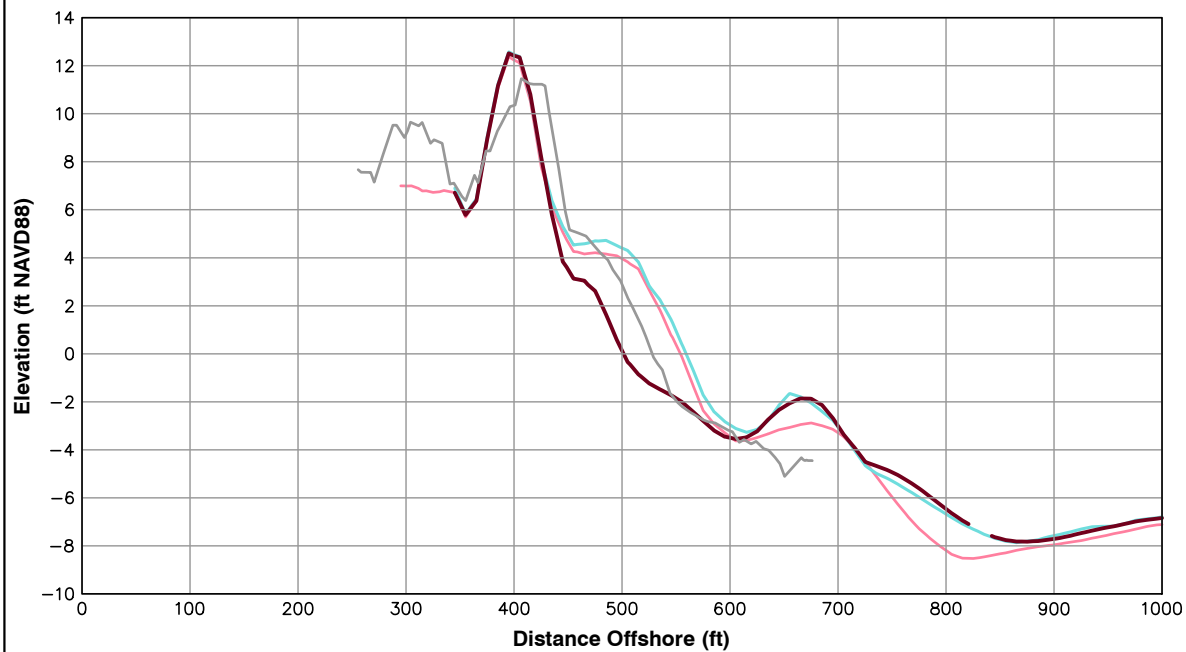
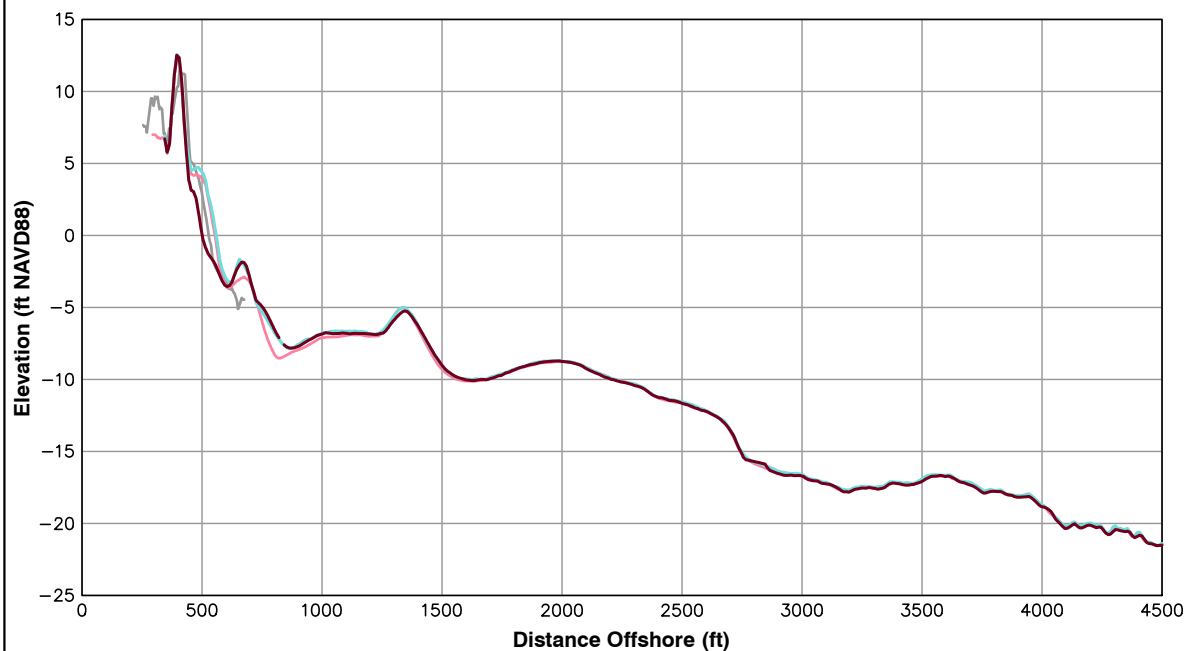
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 17+50**

**Pg 8 of 106**

**Fall 2013**





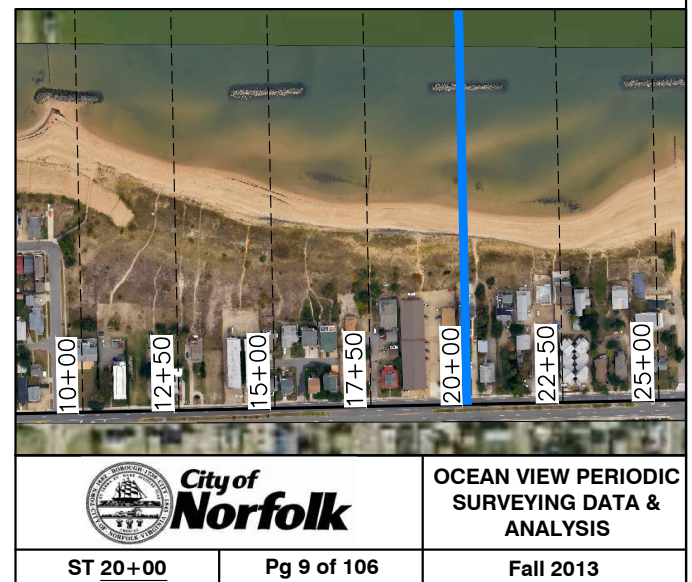
Survey Transect 20+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-49.11 ft/yr	-58.37 ft
Volume Change Above -15 ft NAVD88	-0.20 cy/ft/yr	-19.21 cy/ft
Volume Change Above 0 ft NAVD88	-7.99 cy/ft/yr	-10.88 cy/ft

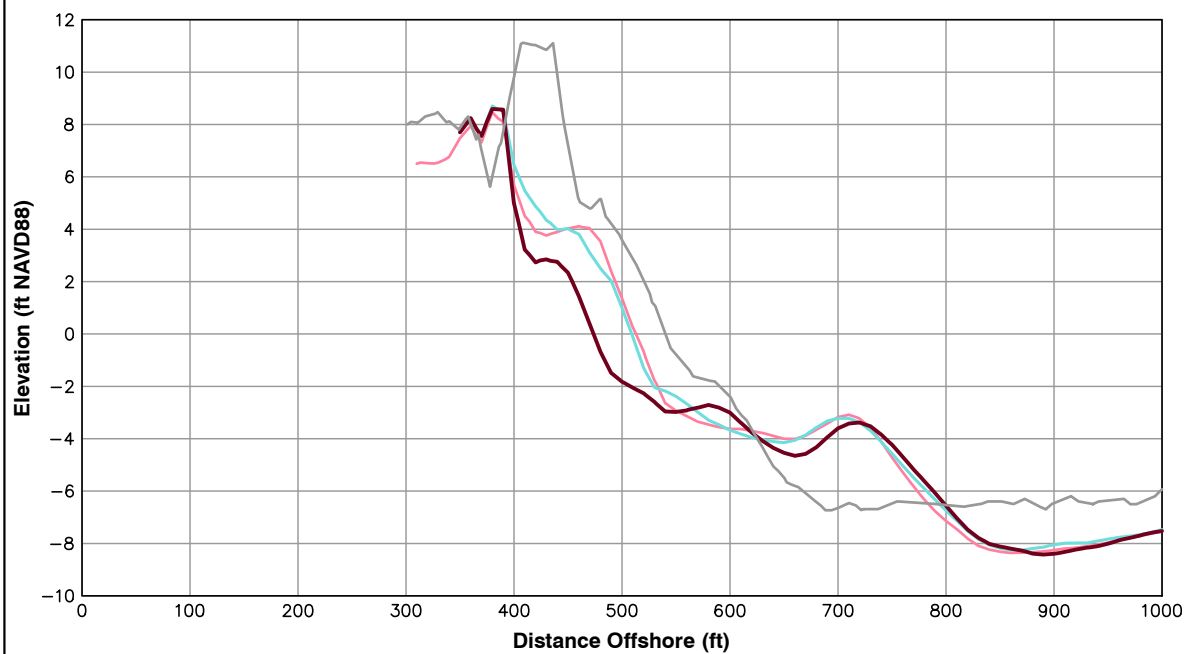
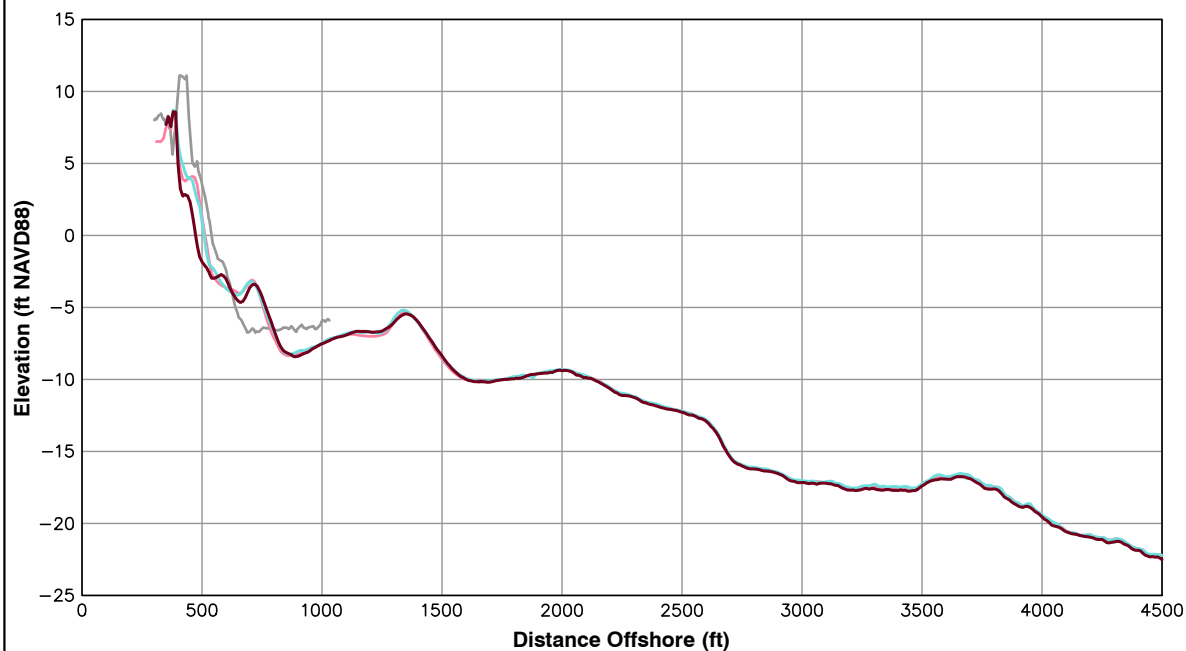
**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.





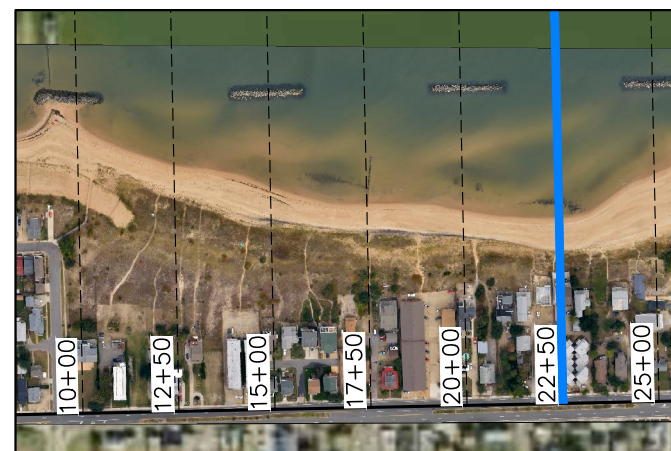
Survey Transect 22+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-36.95 ft/yr	-35.74 ft
Volume Change Above -15 ft NAVD88	-8.04 cy/ft/yr	-15.18 cy/ft
Volume Change Above 0 ft NAVD88	-6.84 cy/ft/yr	-7.75 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



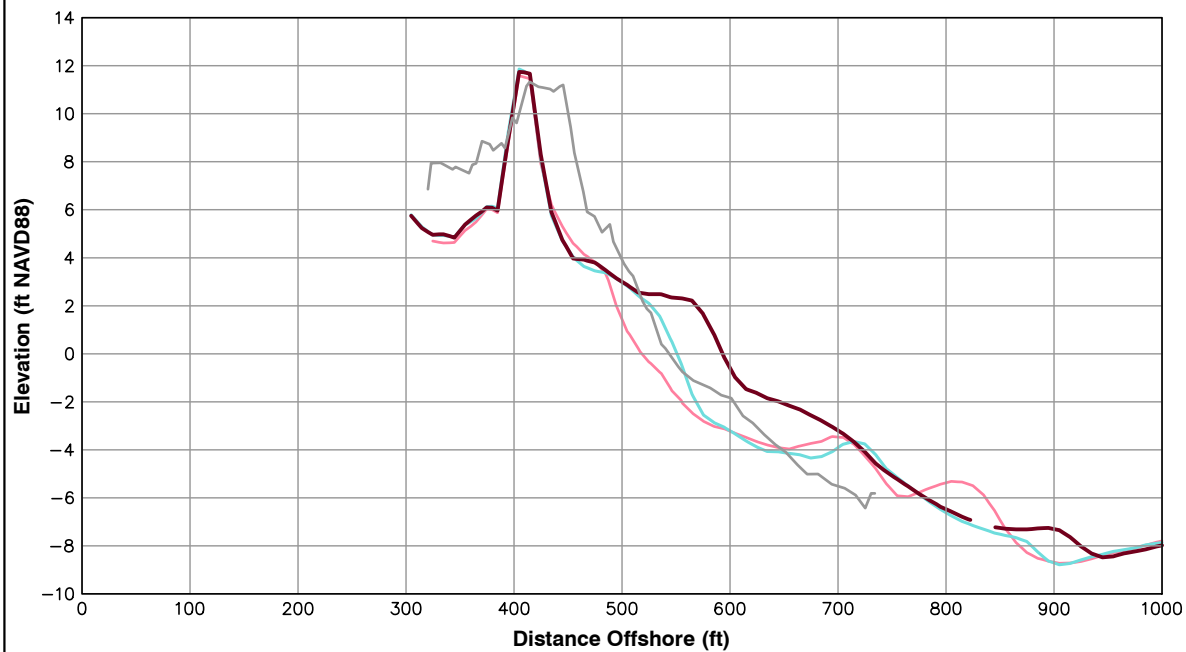
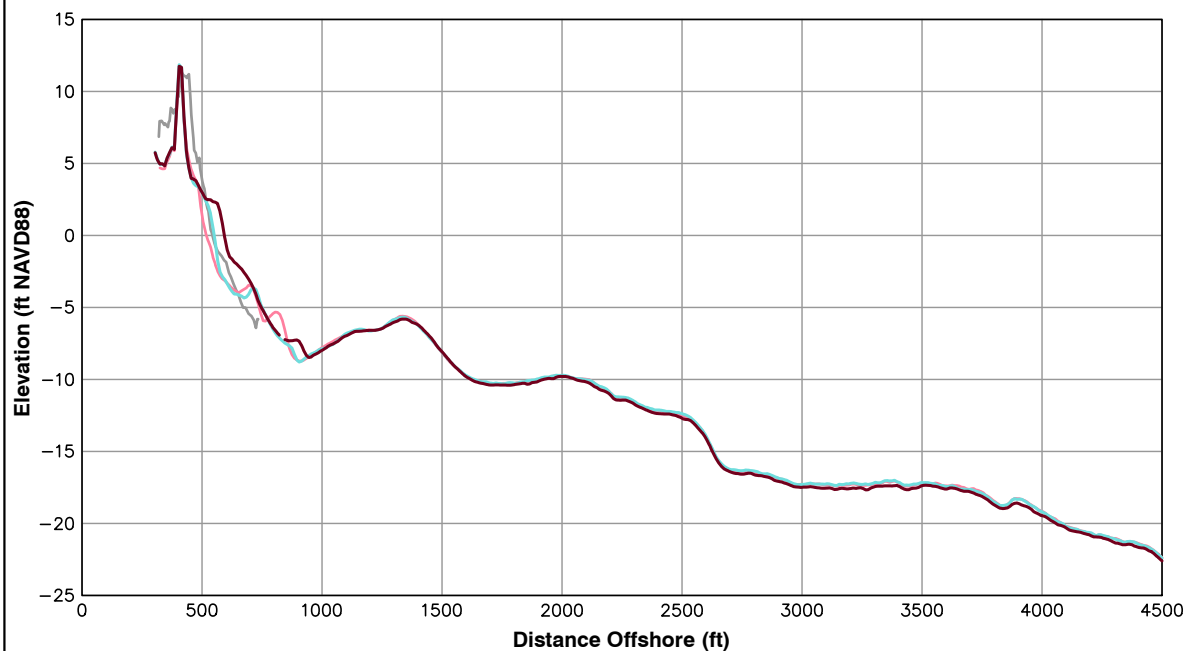
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 22+50**

**Pg 10 of 106**

**Fall 2013**





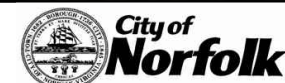
Survey Transect 25+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	74.54 ft/yr	42.11 ft
Volume Change Above -15 ft NAVD88	13.88 cy/ft/yr	10.03 cy/ft
Volume Change Above 0 ft NAVD88	7.14 cy/ft/yr	4.04 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

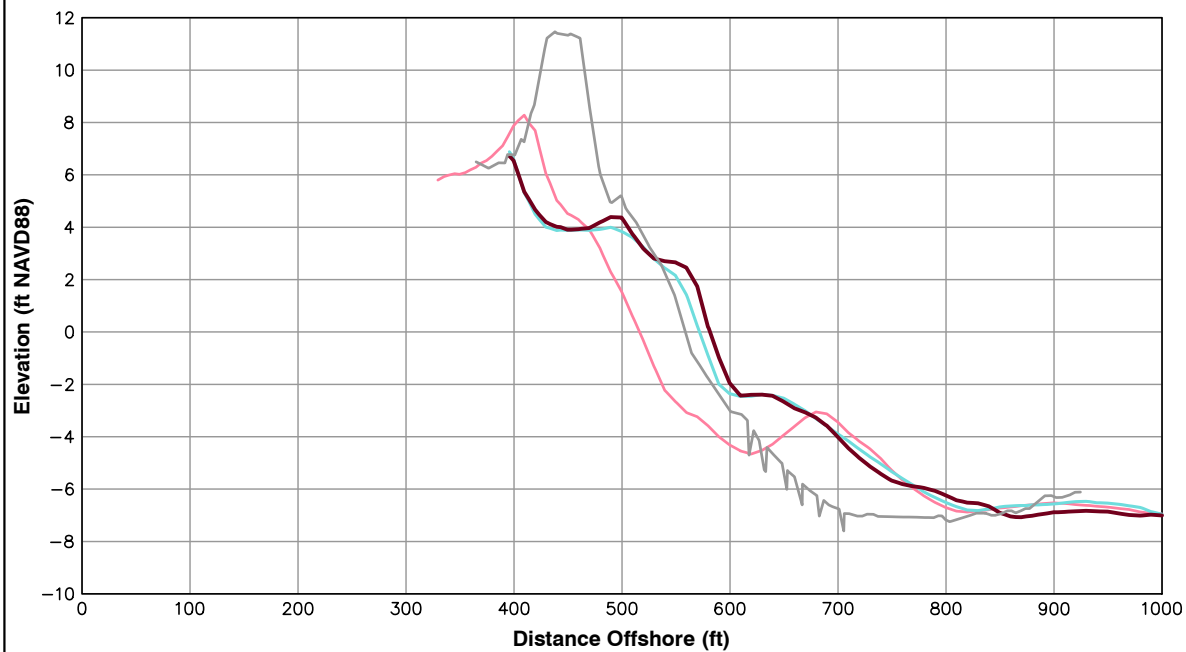
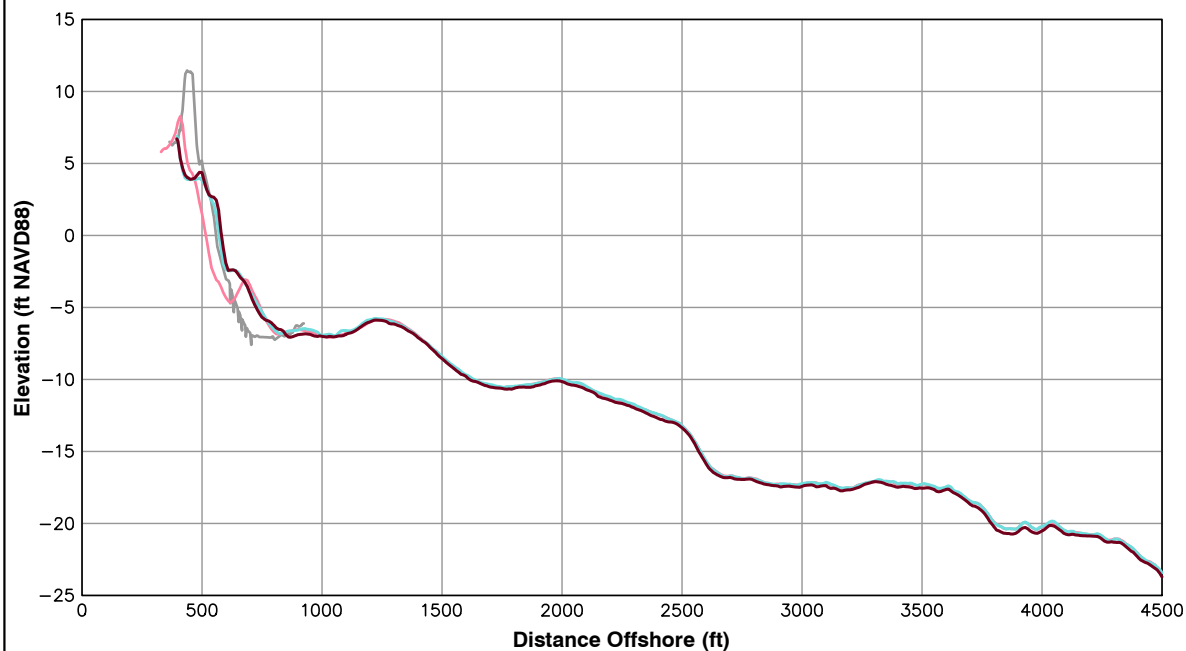


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 25+00**

**Pg 11 of 106**

**Fall 2013**



Survey Transect 27+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	65.10 ft/yr	11.16 ft
Volume Change Above -15 ft NAVD88	7.85 cy/ft/yr	-8.50 cy/ft
Volume Change Above 0 ft NAVD88	4.90 cy/ft/yr	1.99 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

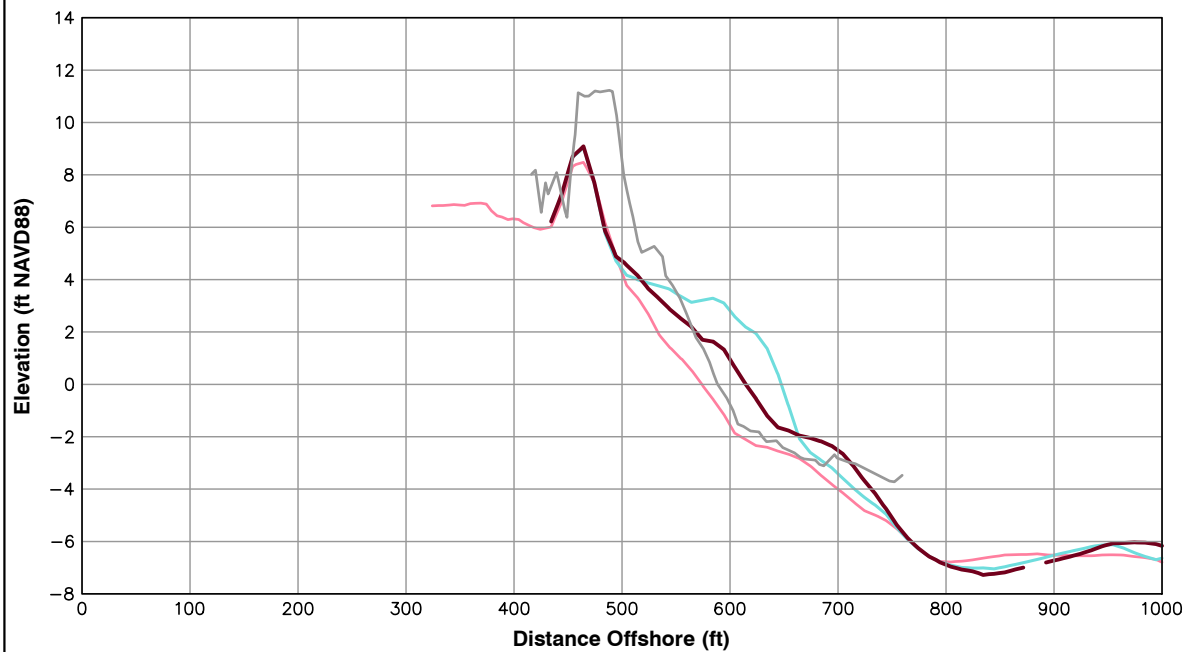
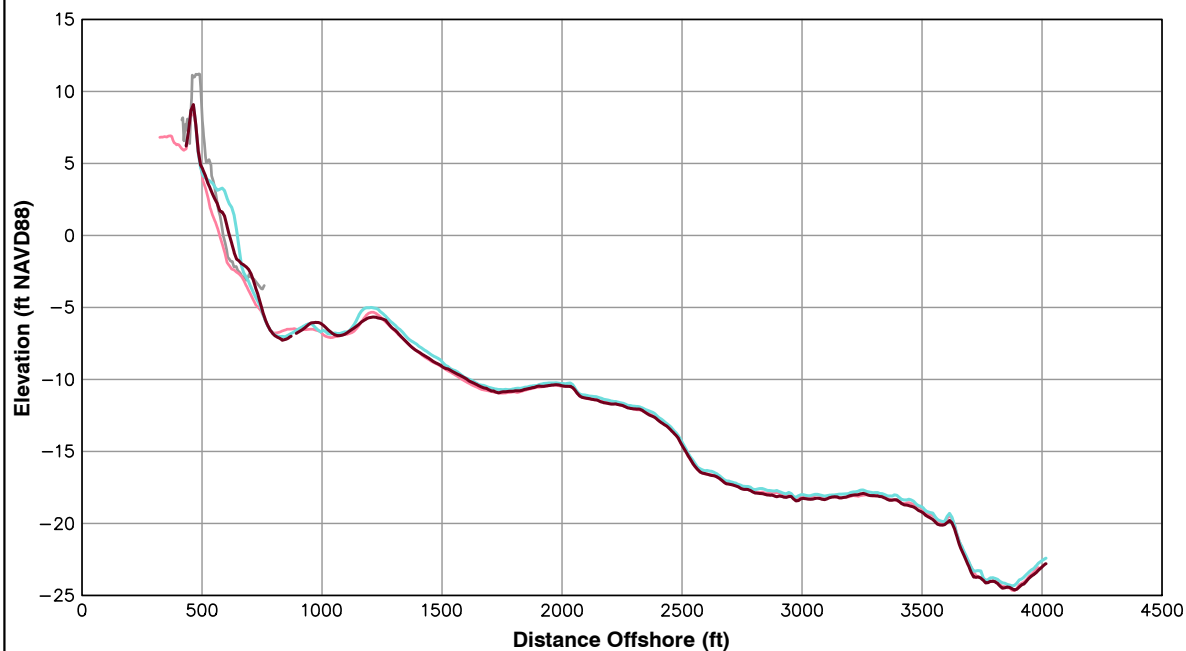
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 27+50**

**Pg 12 of 106**

**Fall 2013**





Survey Transect 30+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	42.49 ft/yr	-38.66 ft
Volume Change Above -15 ft NAVD88	14.59 cy/ft/yr	-17.85 cy/ft
Volume Change Above 0 ft NAVD88	5.24 cy/ft/yr	-5.51 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

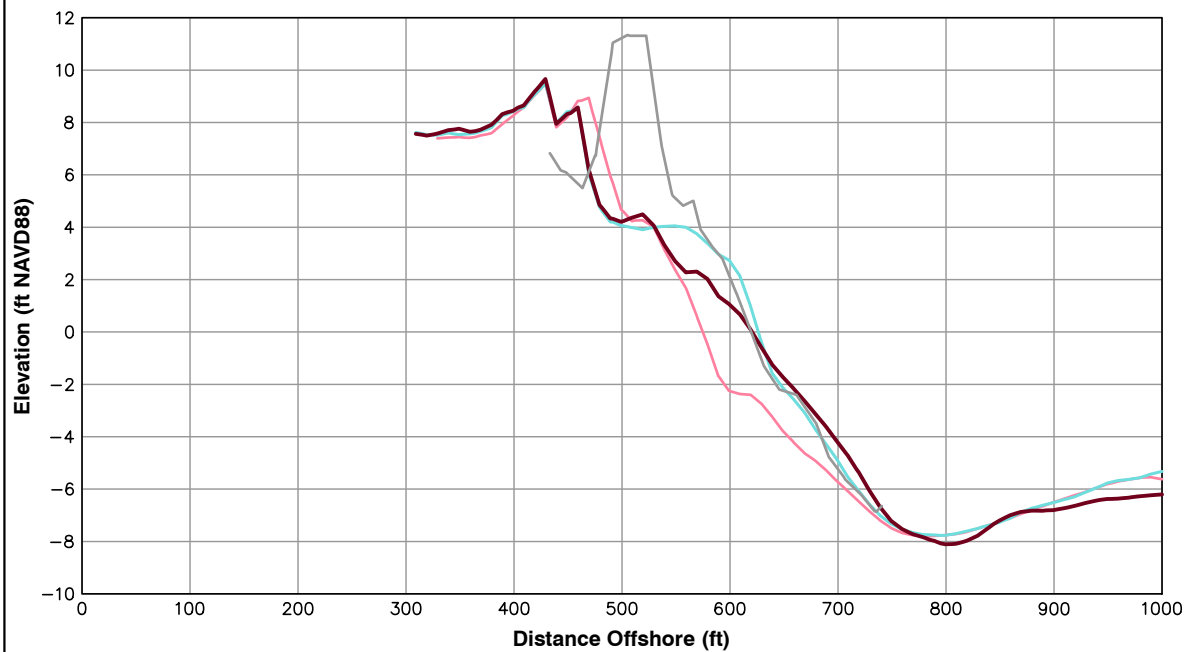
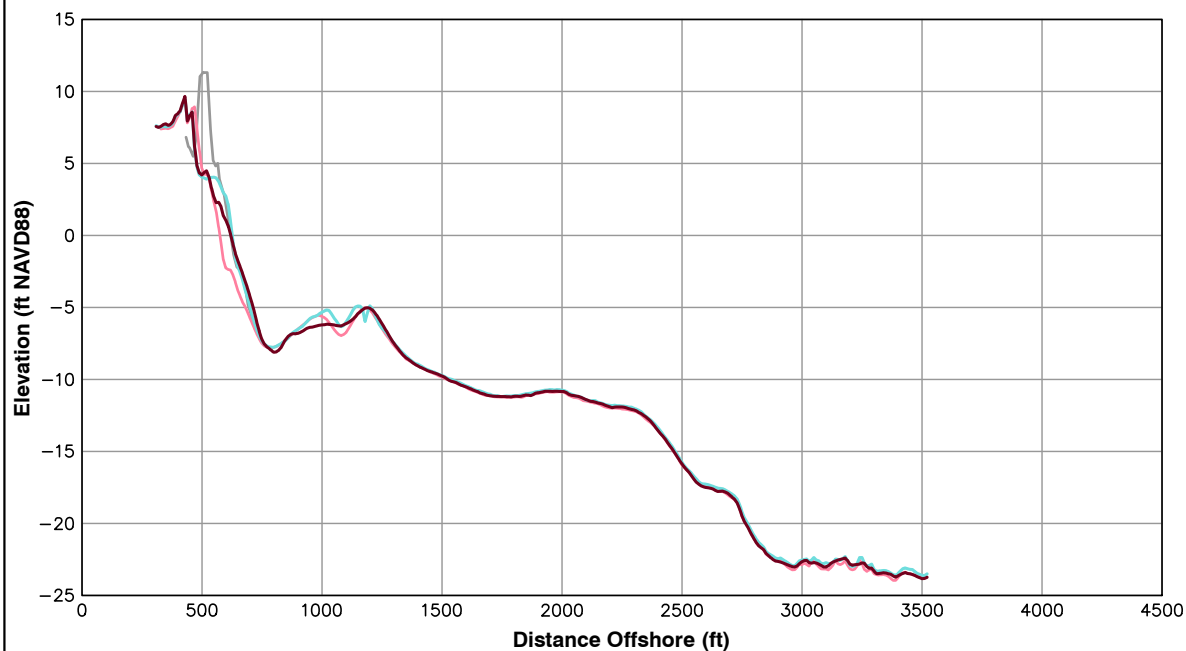


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 30+00**

**Pg 13 of 106**

**Fall 2013**



Survey Transect 32+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	33.59 ft/yr	-17.80 ft
Volume Change Above -15 ft NAVD88	13.01 cy/ft/yr	-10.04 cy/ft
Volume Change Above 0 ft NAVD88	1.24 cy/ft/yr	-3.58 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

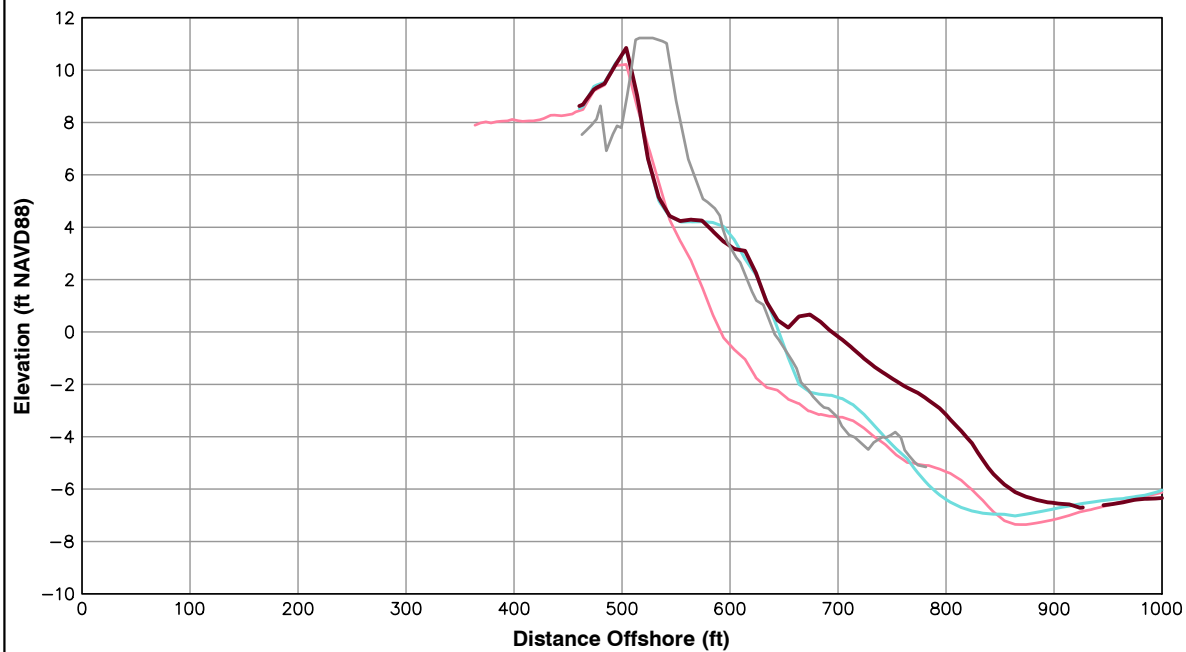
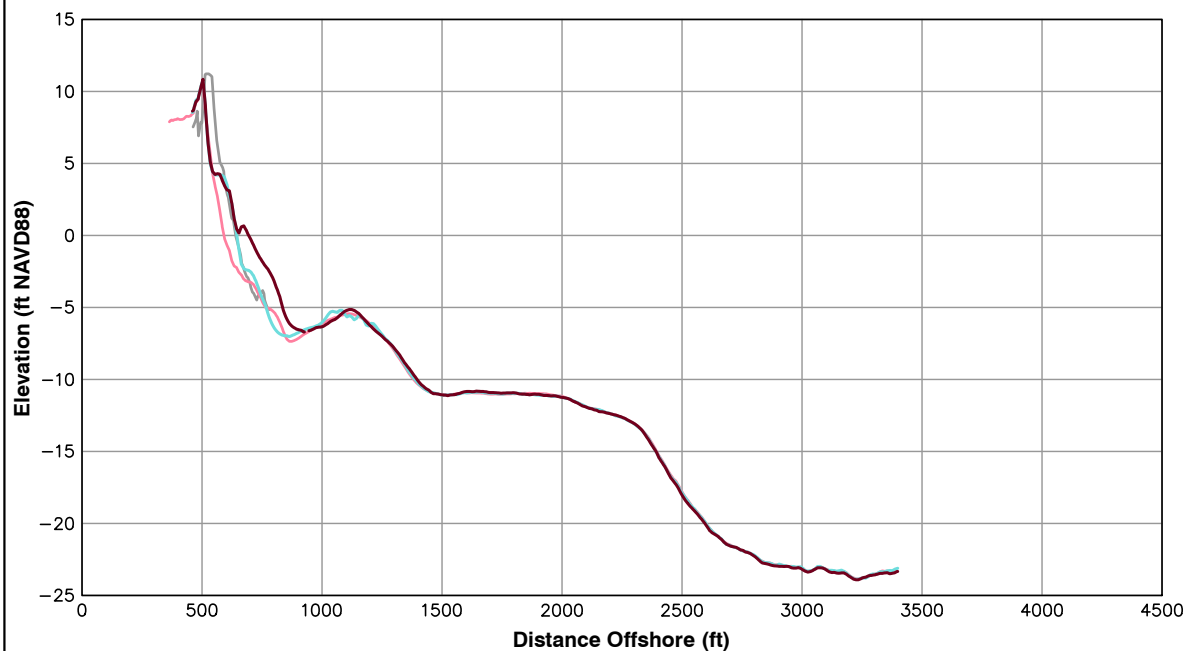
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 32+50**

**Pg 14 of 106**

**Fall 2013**





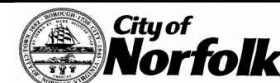
Survey Transect 35+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	52.35 ft/yr	0.32 ft
Volume Change Above -15 ft NAVD88	31.92 cy/ft/yr	19.68 cy/ft
Volume Change Above 0 ft NAVD88	8.38 cy/ft/yr	0.58 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

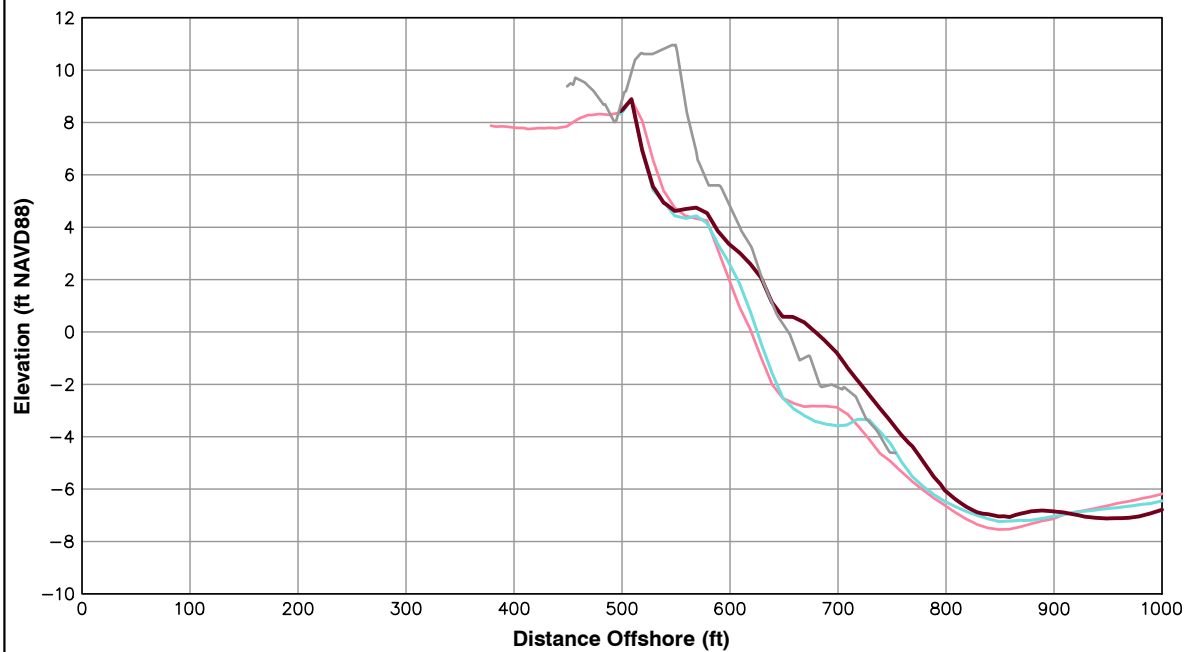
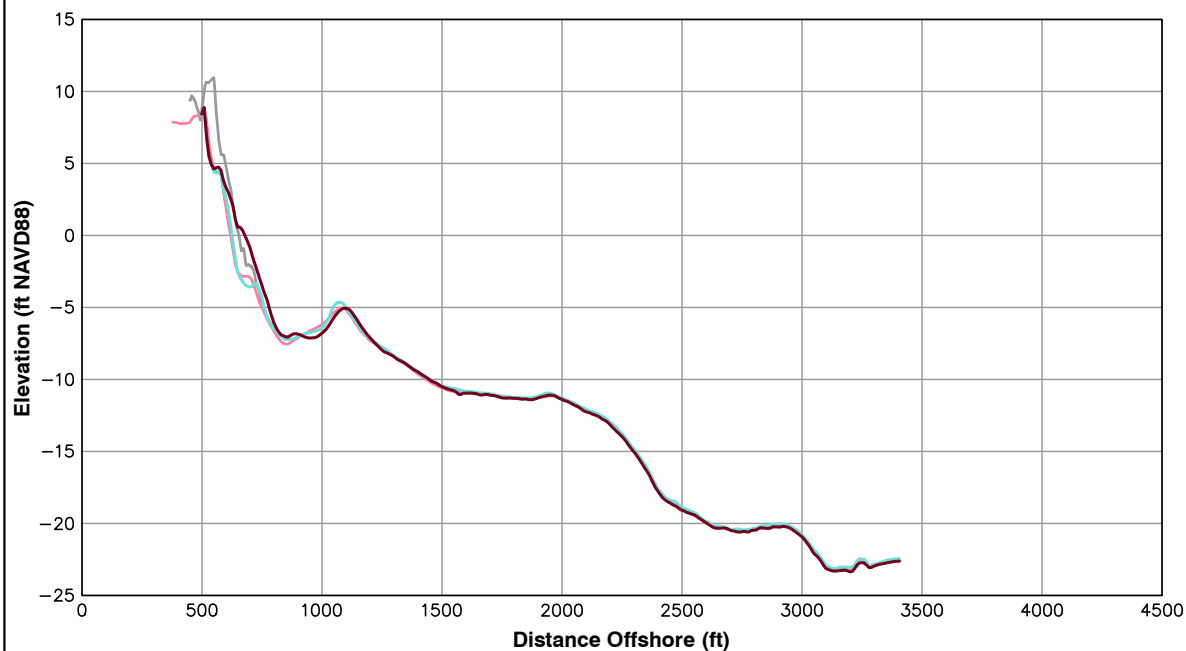


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 35+00**

**Pg 15 of 106**

**Fall 2013**



Survey Transect 37+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	31.16 ft/yr	24.68 ft
Volume Change Above -15 ft NAVD88	14.00 cy/ft/yr	9.32 cy/ft
Volume Change Above 0 ft NAVD88	3.39 cy/ft/yr	3.89 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



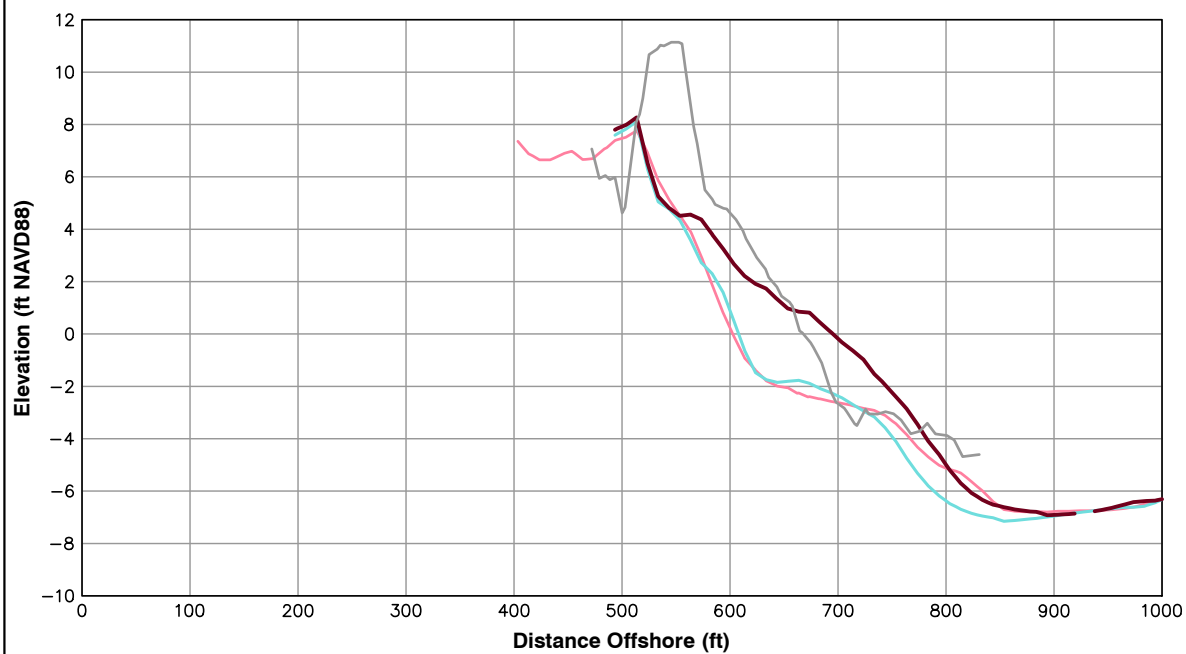
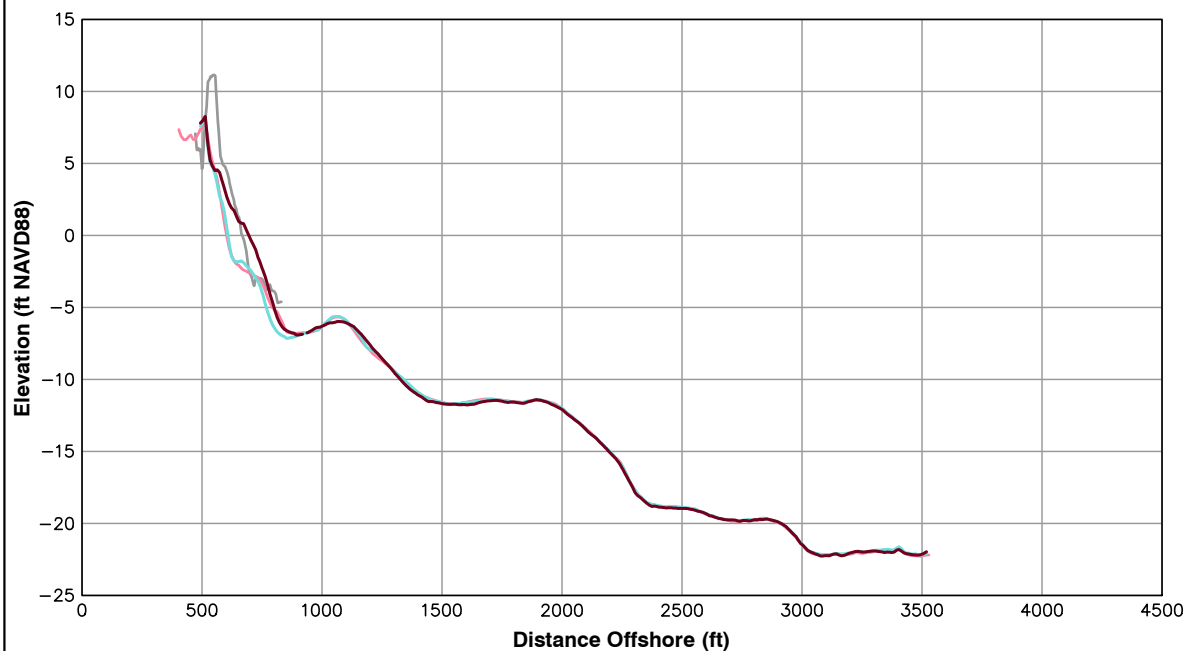
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 37+50**

**Pg 16 of 106**

**Fall 2013**





Survey Transect 40+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	57.98 ft/yr	54.18 ft
Volume Change Above -15 ft NAVD88	15.14 cy/ft/yr	19.10 cy/ft
Volume Change Above 0 ft NAVD88	6.76 cy/ft/yr	7.21 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

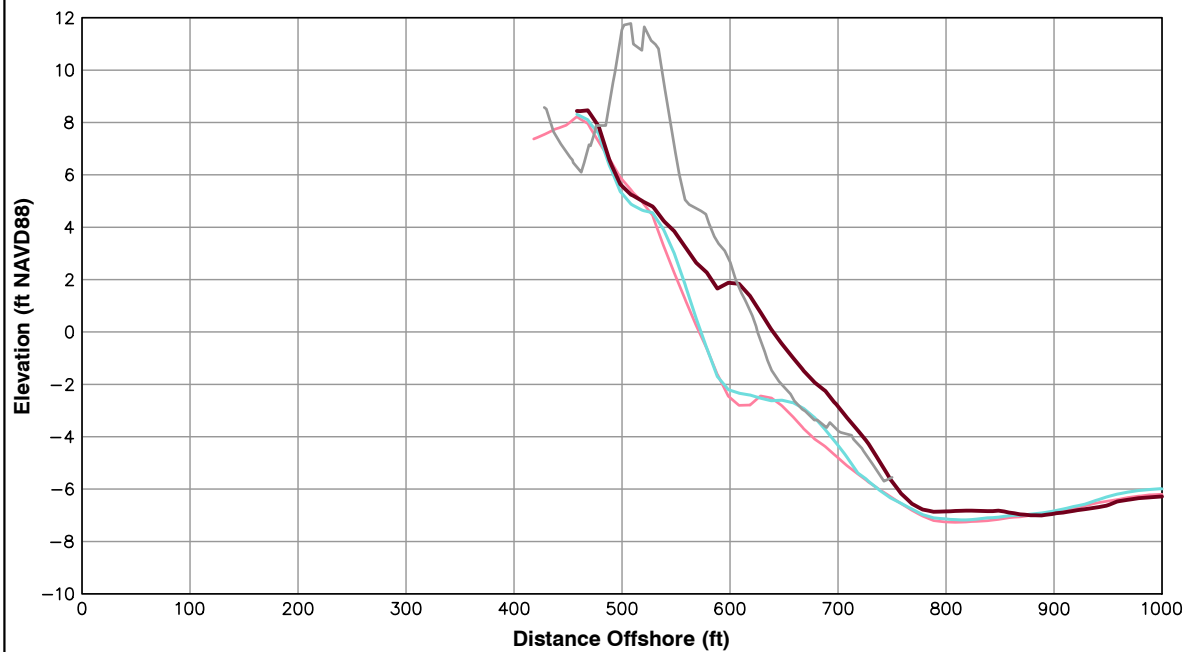
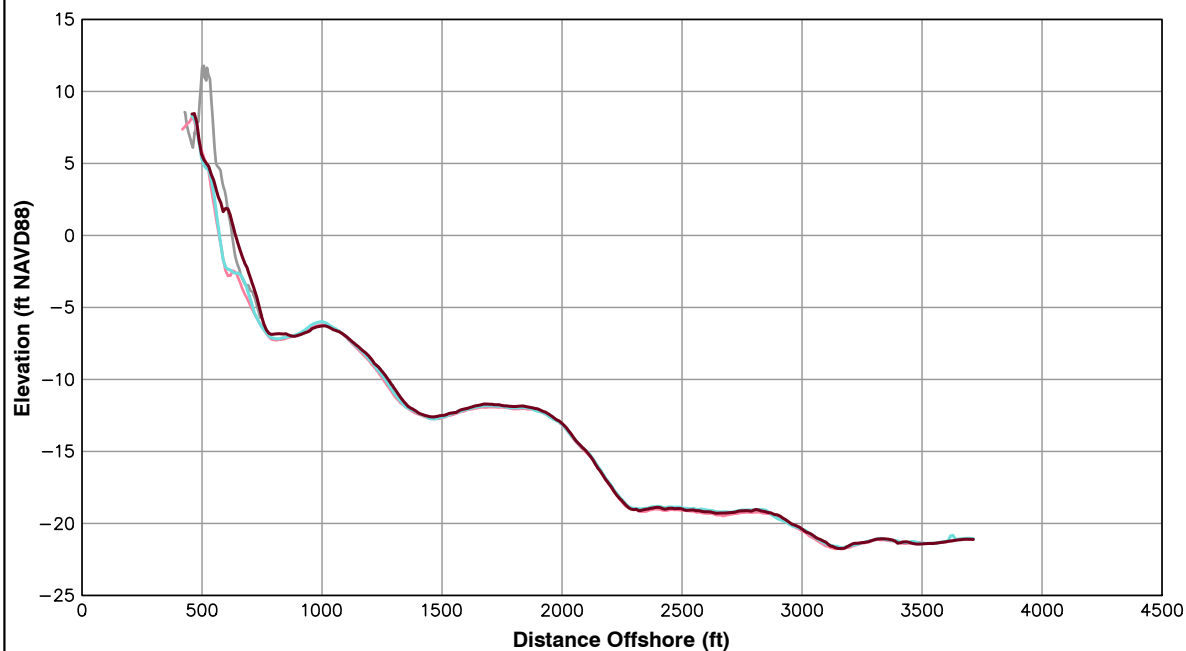


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 40+00**

**Pg 17 of 106**

**Fall 2013**



Survey Transect 42+50	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	60.03 ft/yr	59.66 ft
Volume Change Above -15 ft NAVD88	25.81 cy/ft/yr	21.42 cy/ft
Volume Change Above 0 ft NAVD88	6.28 cy/ft/yr	6.24 cy/ft

**LEGEND:**



**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



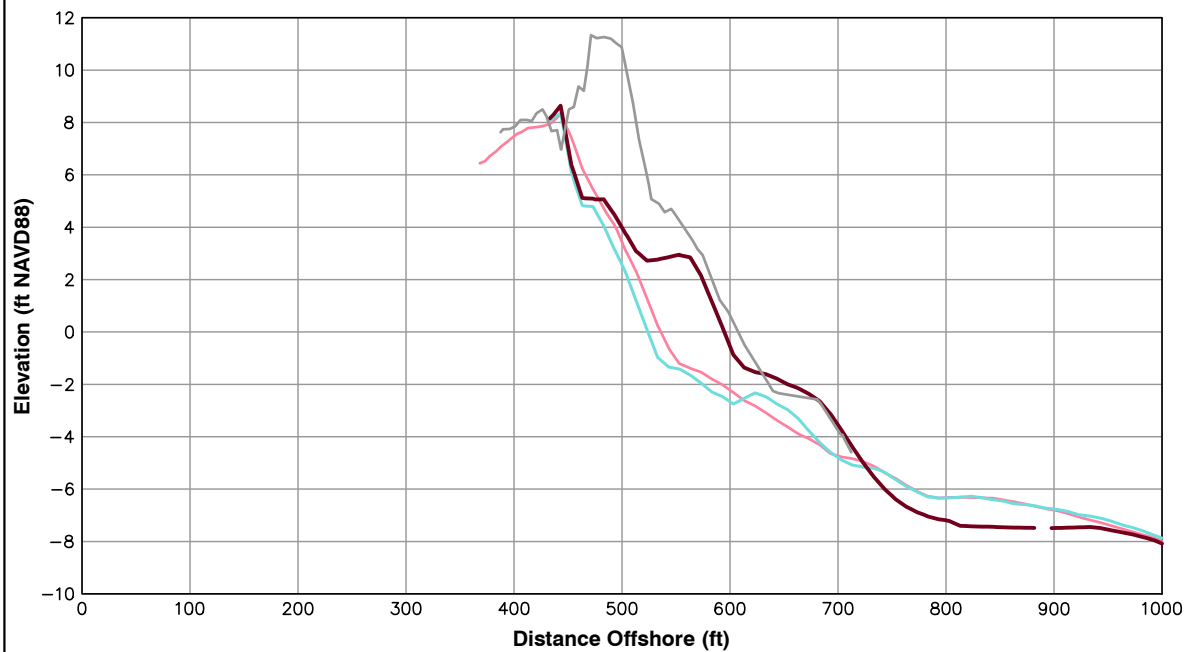
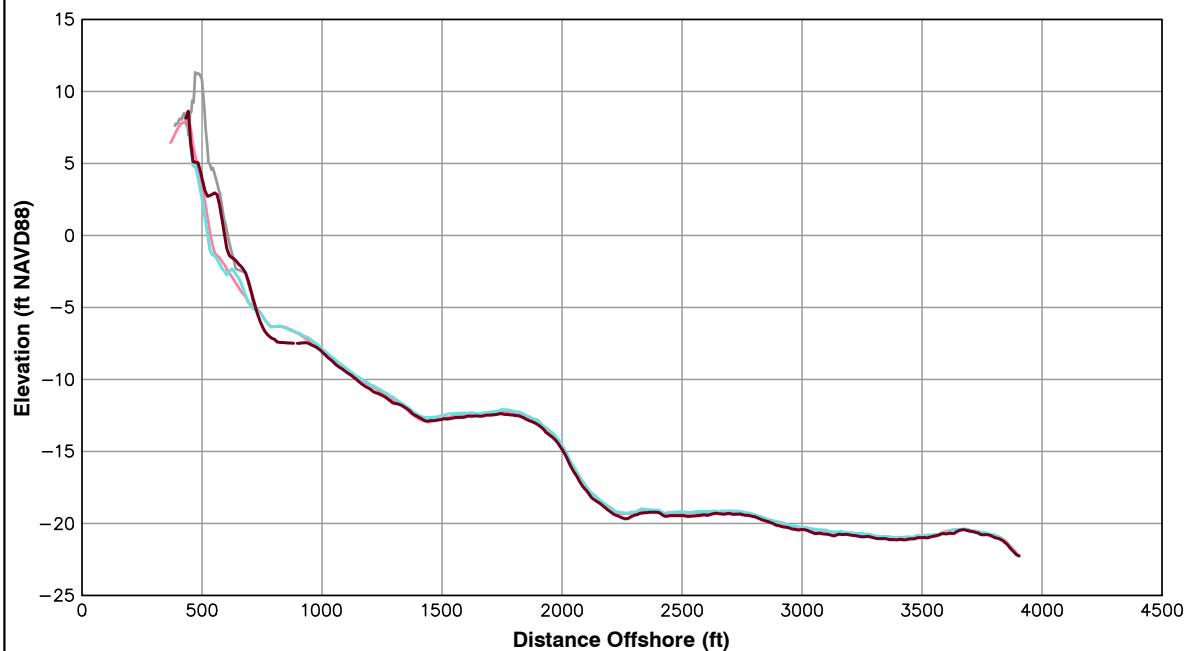
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 42+50**

**Pg 18 of 106**

**Fall 2013**





Survey Transect 45+00	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	55.72 ft/yr	69.92 ft
Volume Change Above -15 ft NAVD88	4.52 cy/ft/yr	2.80 cy/ft
Volume Change Above 0 ft NAVD88	5.65 cy/ft/yr	9.03 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

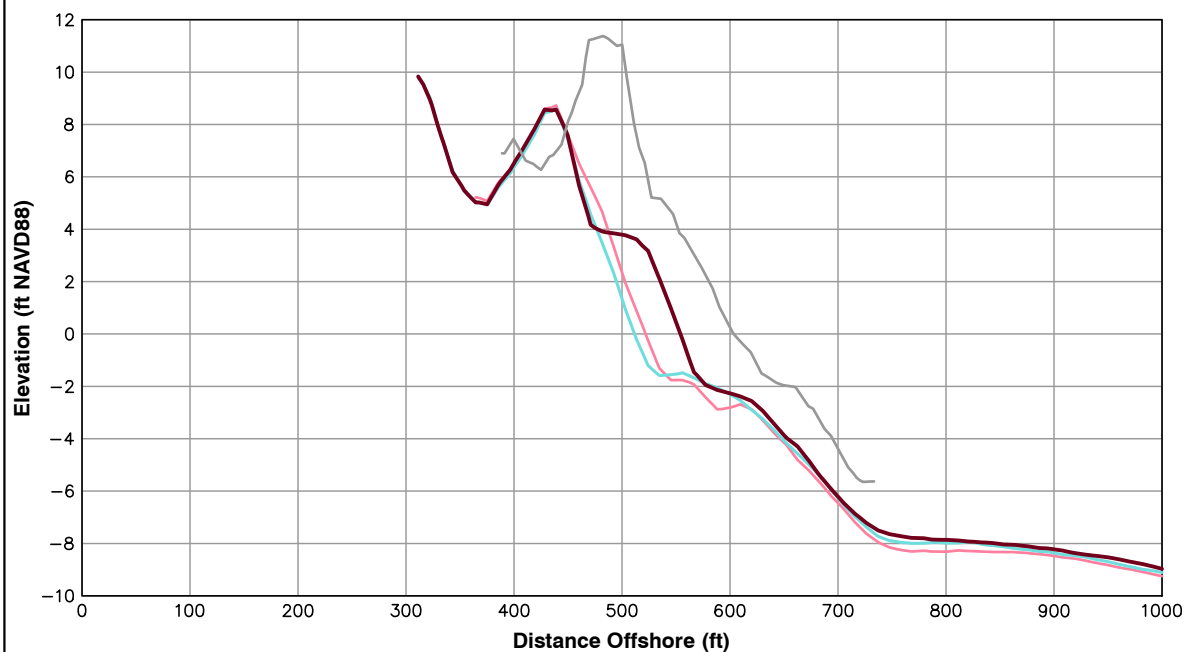
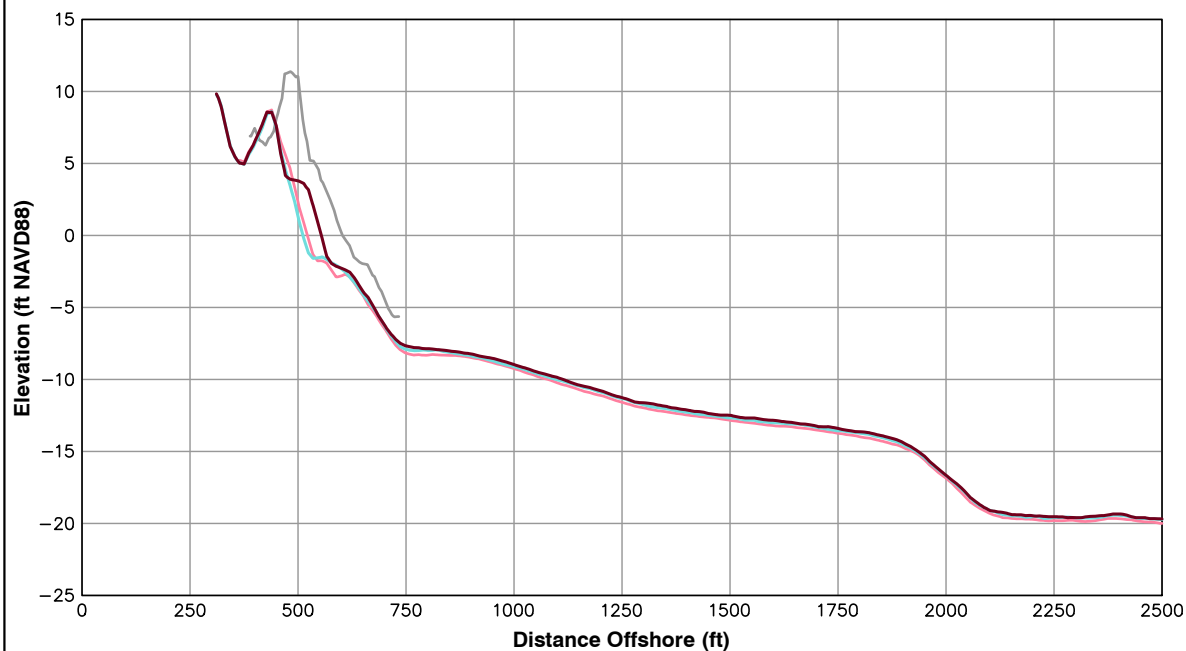


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 45+00**

**Pg 19 of 106**

**Fall 2013**



Survey Transect 45+25	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	31.07 ft/yr	42.48 ft
Volume Change Above -15 ft NAVD88	20.92 cy/ft/yr	14.55 cy/ft
Volume Change Above 0 ft NAVD88	2.91 cy/ft/yr	5.83 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



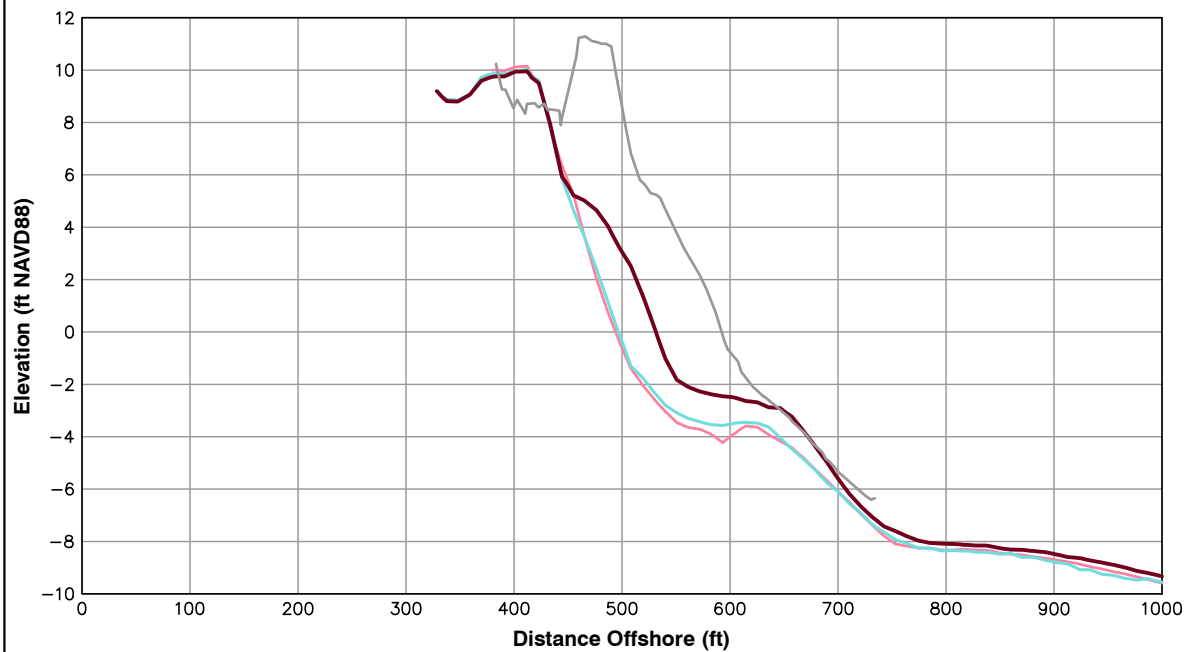
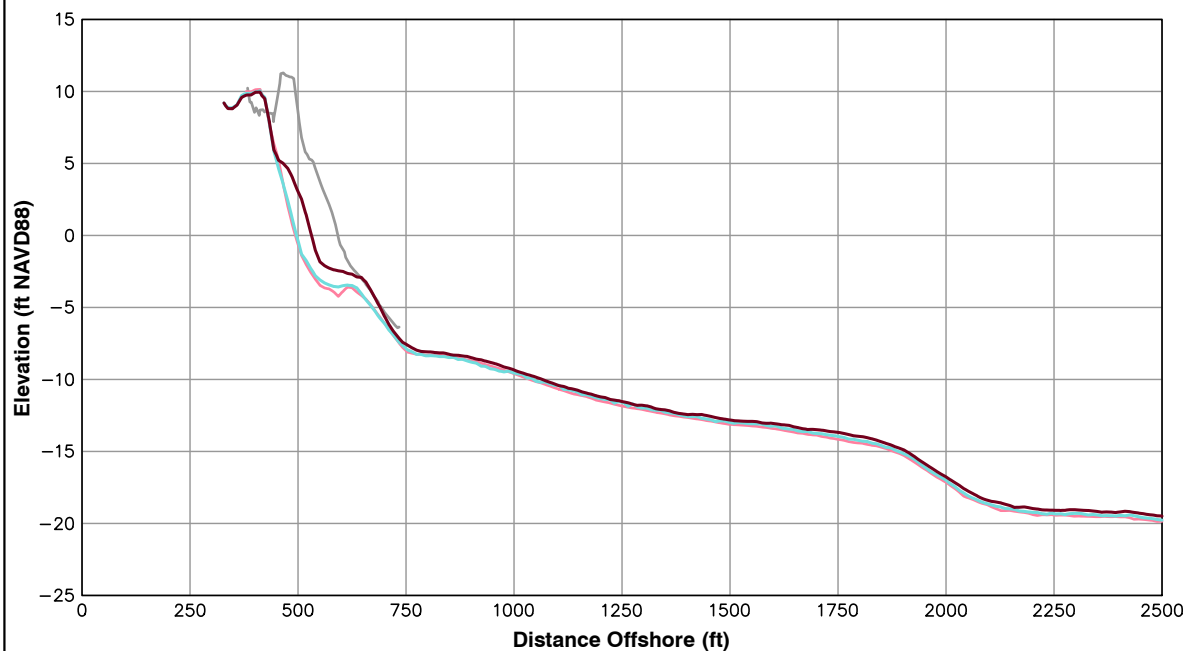
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 45+25

Pg 20 of 106

Fall 2013





Survey Transect 47+30	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	35.75 ft/yr	34.44 ft
Volume Change Above -15 ft NAVD88	27.64 cy/ft/yr	23.38 cy/ft
Volume Change Above 0 ft NAVD88	5.12 cy/ft/yr	5.52 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



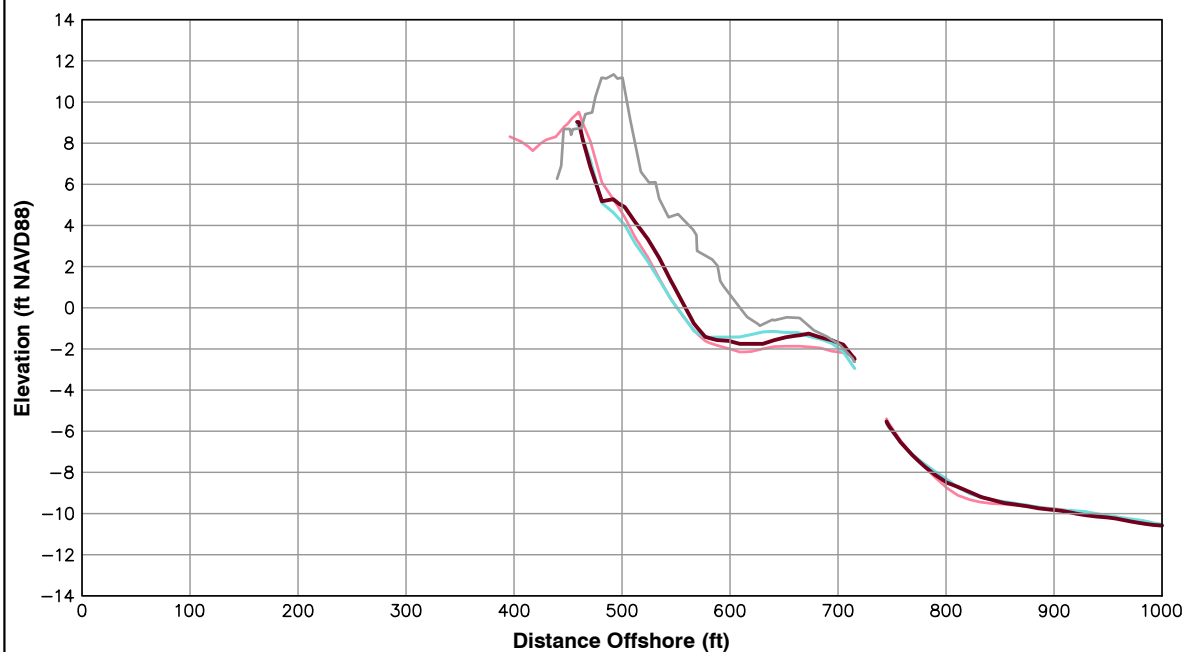
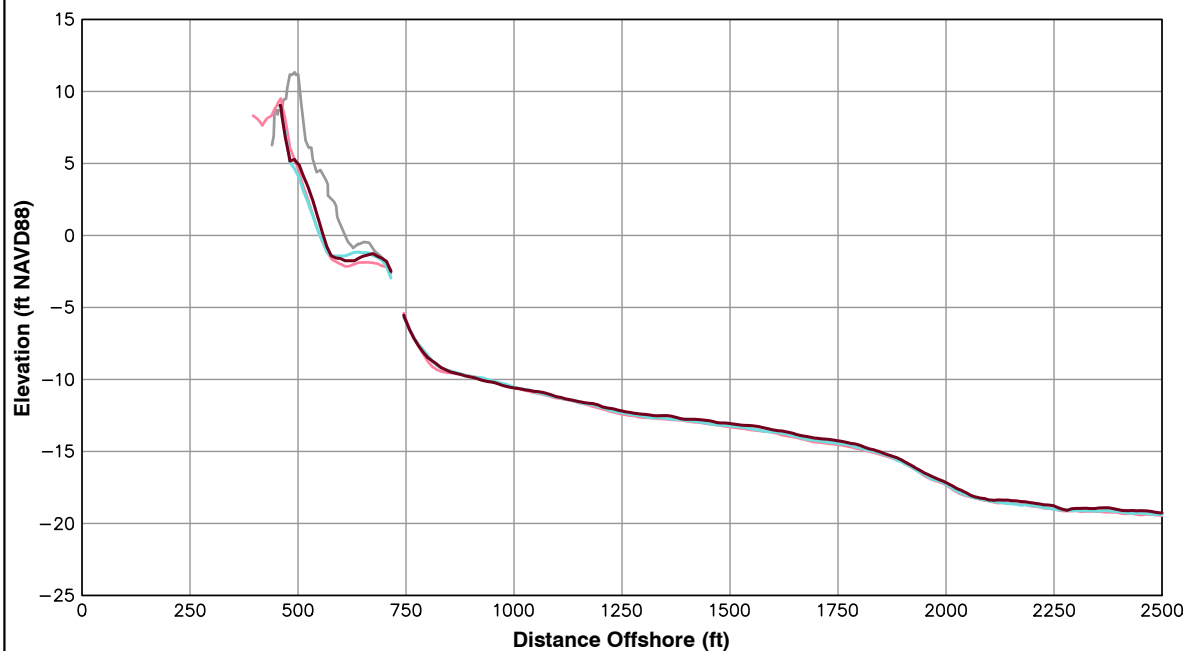
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 47+30**

**Pg 21 of 106**

**Fall 2013**



Survey Transect 49+35	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	8.90 ft/yr	9.82 ft
Volume Change Above -15 ft NAVD88	8.99 cy/ft/yr	5.33 cy/ft
Volume Change Above 0 ft NAVD88	0.66 cy/ft/yr	2.25 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



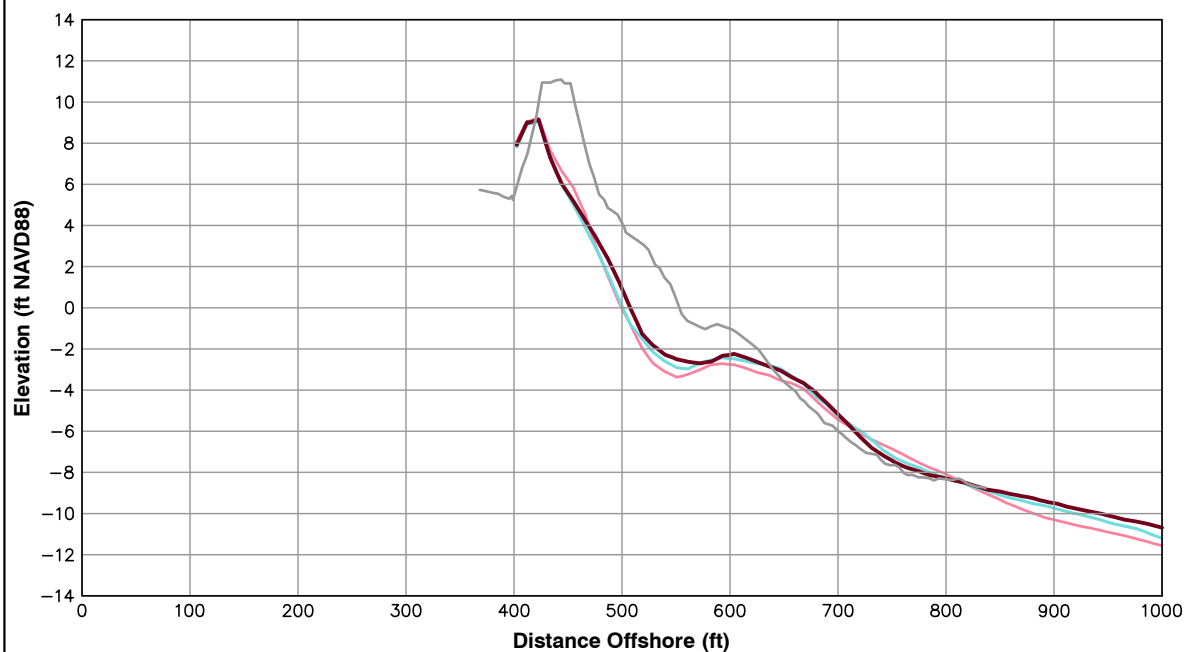
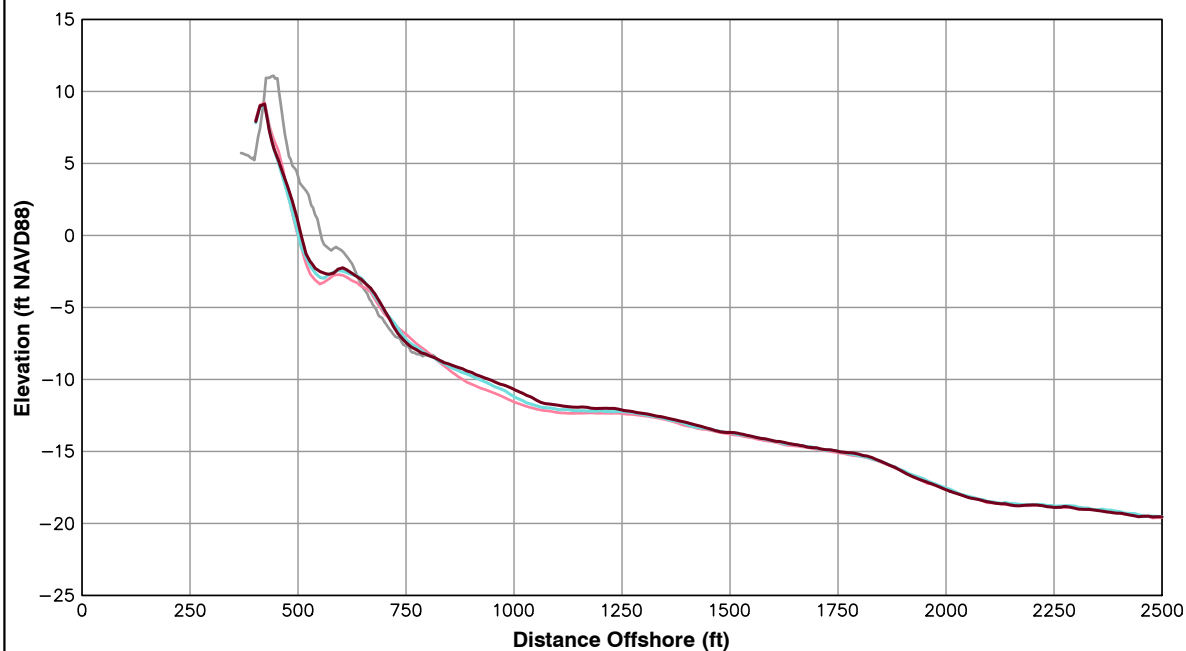
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 49+35**

**Pg 22 of 106**

**Fall 2013**





Survey Transect 51+41	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	7.75 ft/yr	7.08 ft
Volume Change Above -15 ft NAVD88	13.18 cy/ft/yr	6.90 cy/ft
Volume Change Above 0 ft NAVD88	0.07 cy/ft/yr	1.13 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



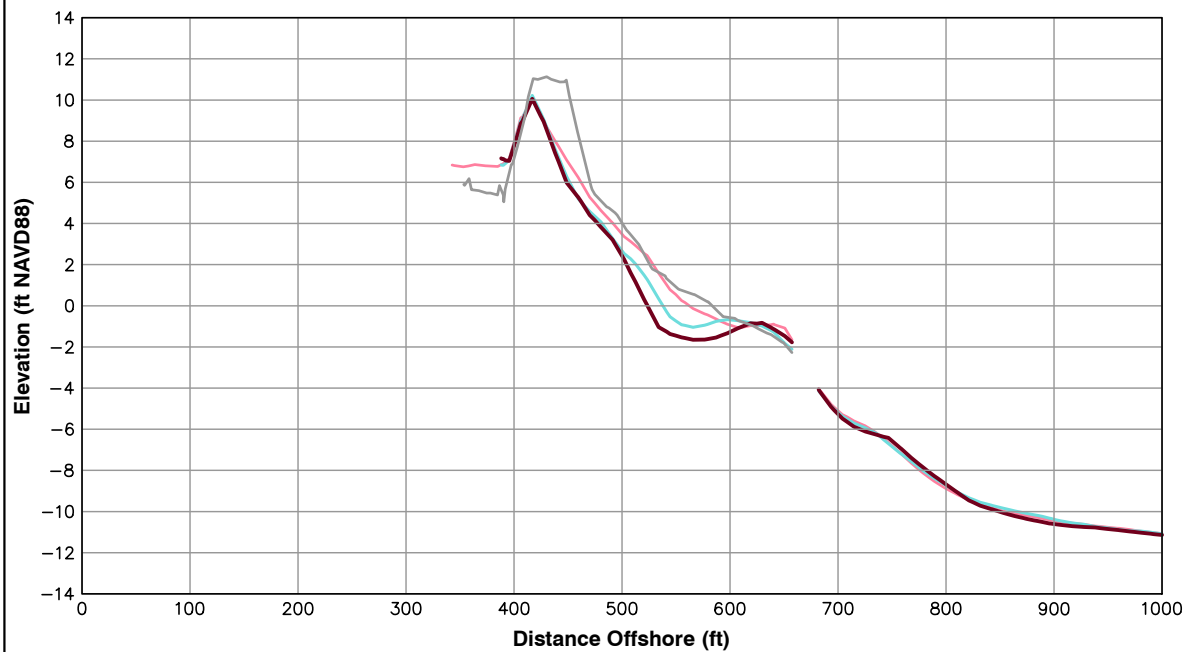
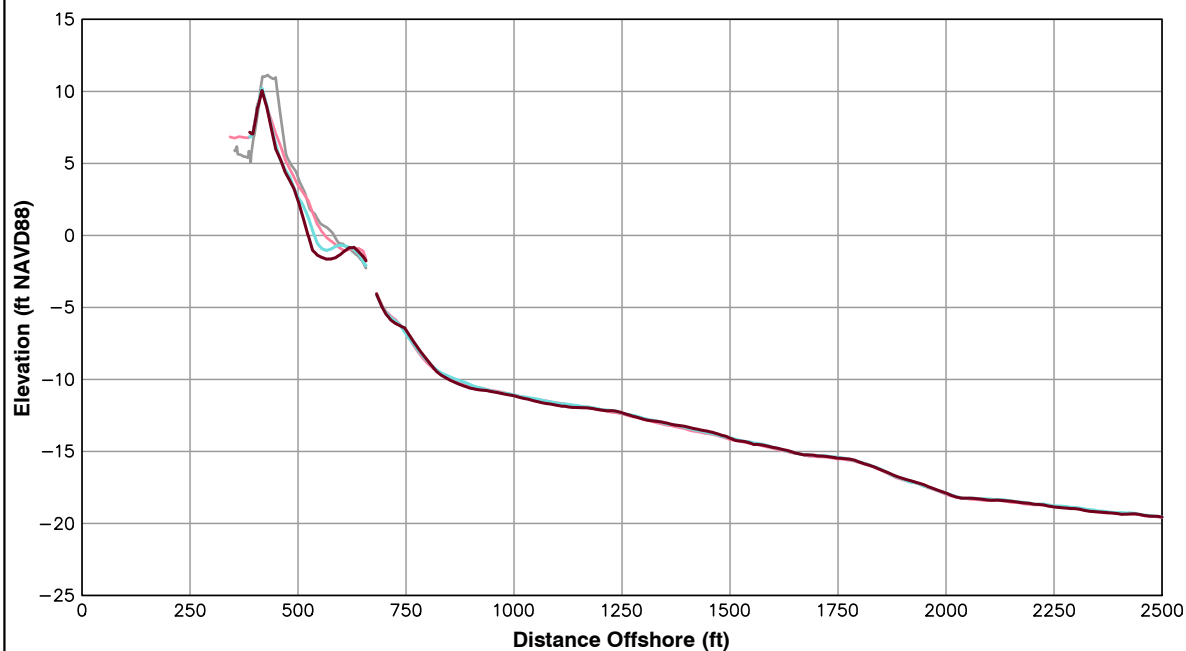
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 51+41

Pg 23 of 106

Fall 2013



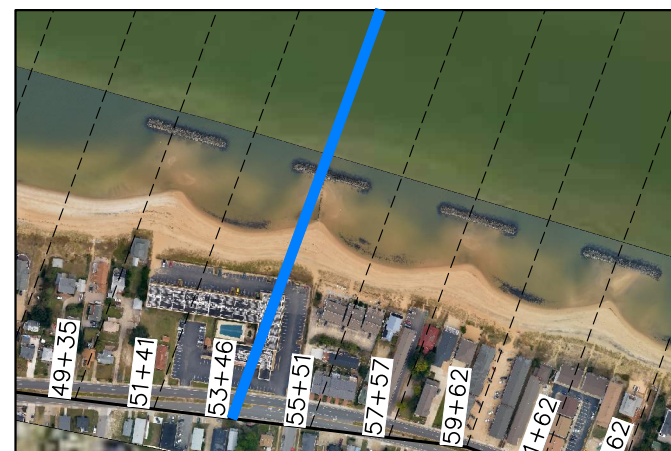
Survey Transect 53+46	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-26.23 ft/yr	-12.57 ft
Volume Change Above -15 ft NAVD88	-7.92 cy/ft/yr	-5.21 cy/ft
Volume Change Above 0 ft NAVD88	-4.95 cy/ft/yr	-1.54 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



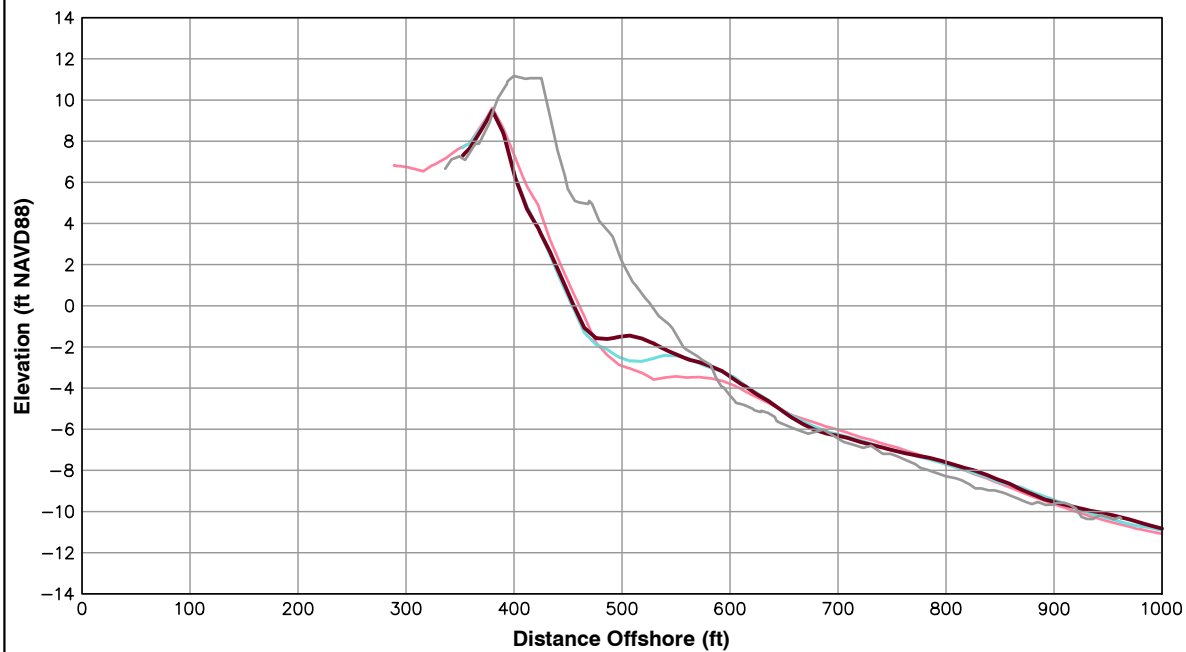
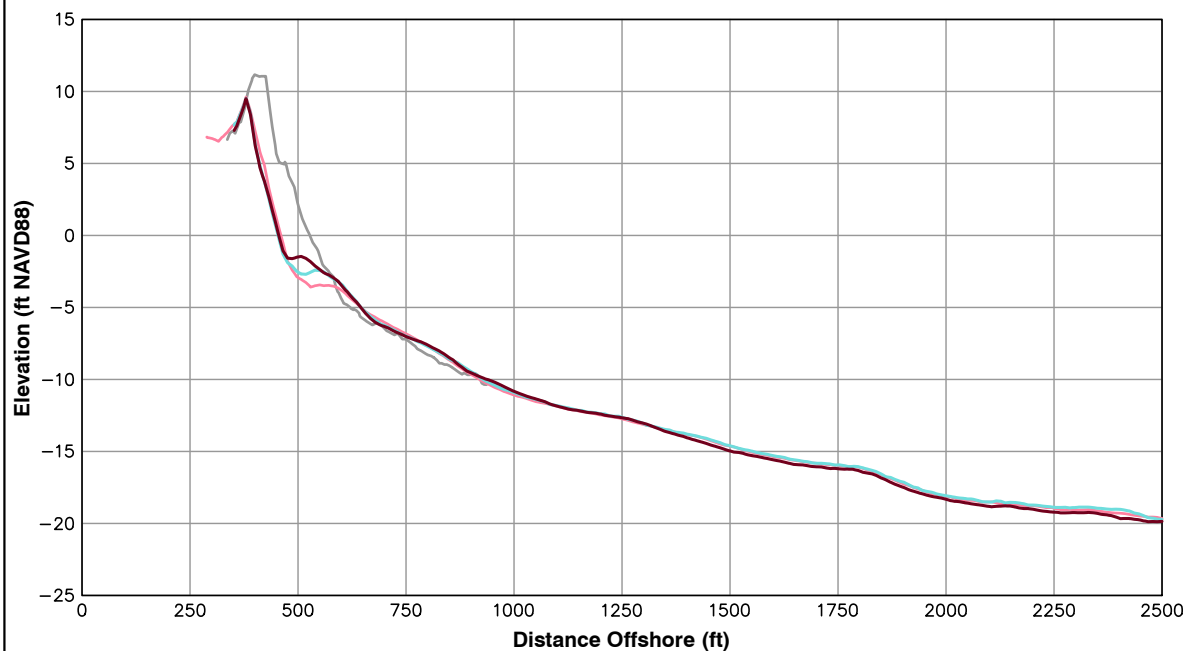
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 53+46**

**Pg 24 of 106**

**Fall 2013**





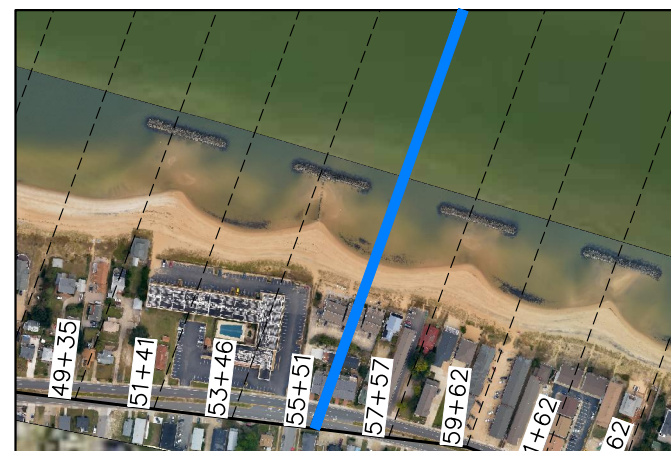
Survey Transect 55+51	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-4.44 ft/yr	1.82 ft
Volume Change Above -15 ft NAVD88	2.31 cy/ft/yr	0.25 cy/ft
Volume Change Above 0 ft NAVD88	-2.13 cy/ft/yr	-0.11 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

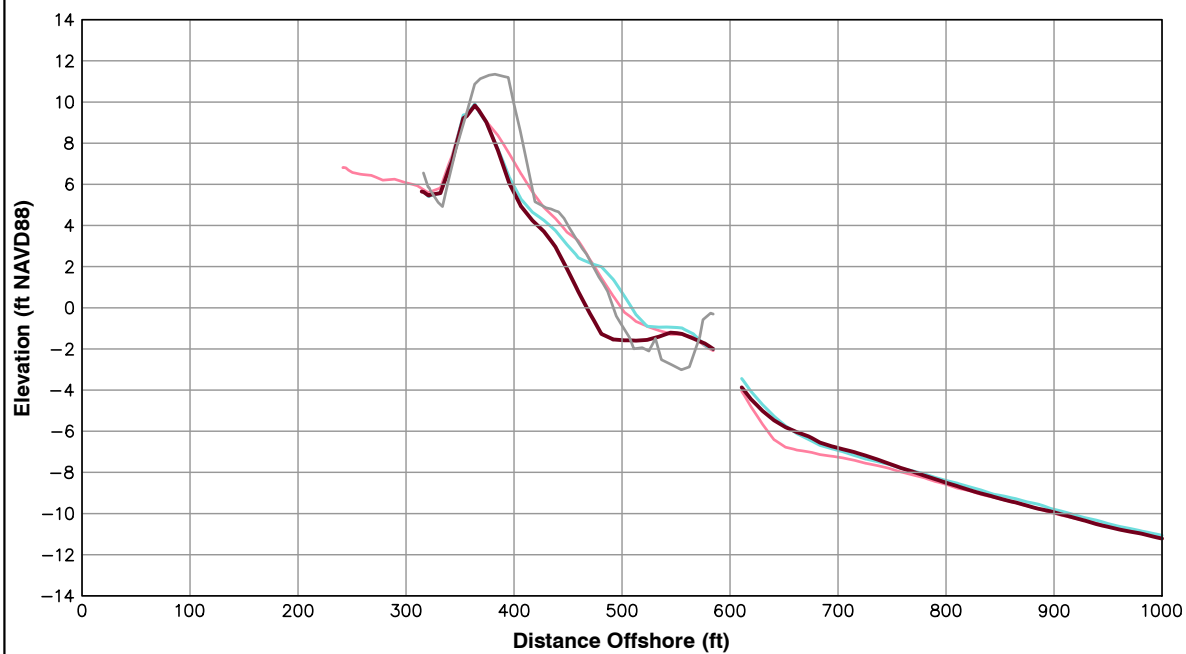
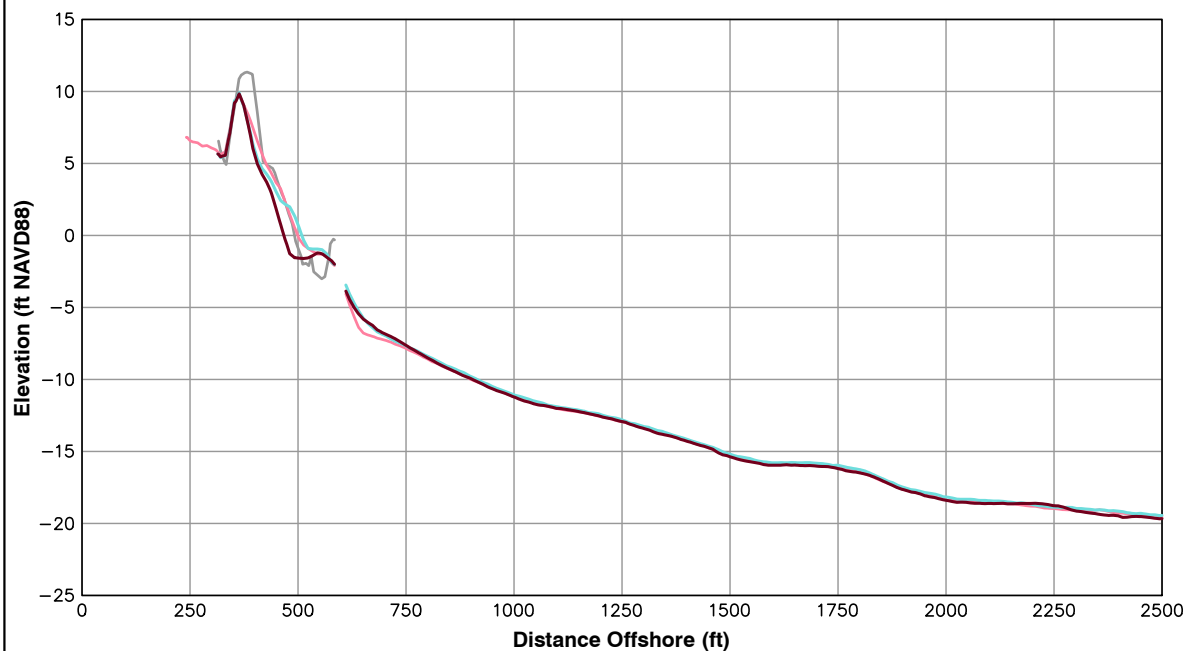


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 55+51**

**Pg 25 of 106**

**Fall 2013**



Survey Transect 57+57	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-27.48 ft/yr	-39.22 ft
Volume Change Above -15 ft NAVD88	-5.80 cy/ft/yr	-11.20 cy/ft
Volume Change Above 0 ft NAVD88	-6.38 cy/ft/yr	-4.58 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



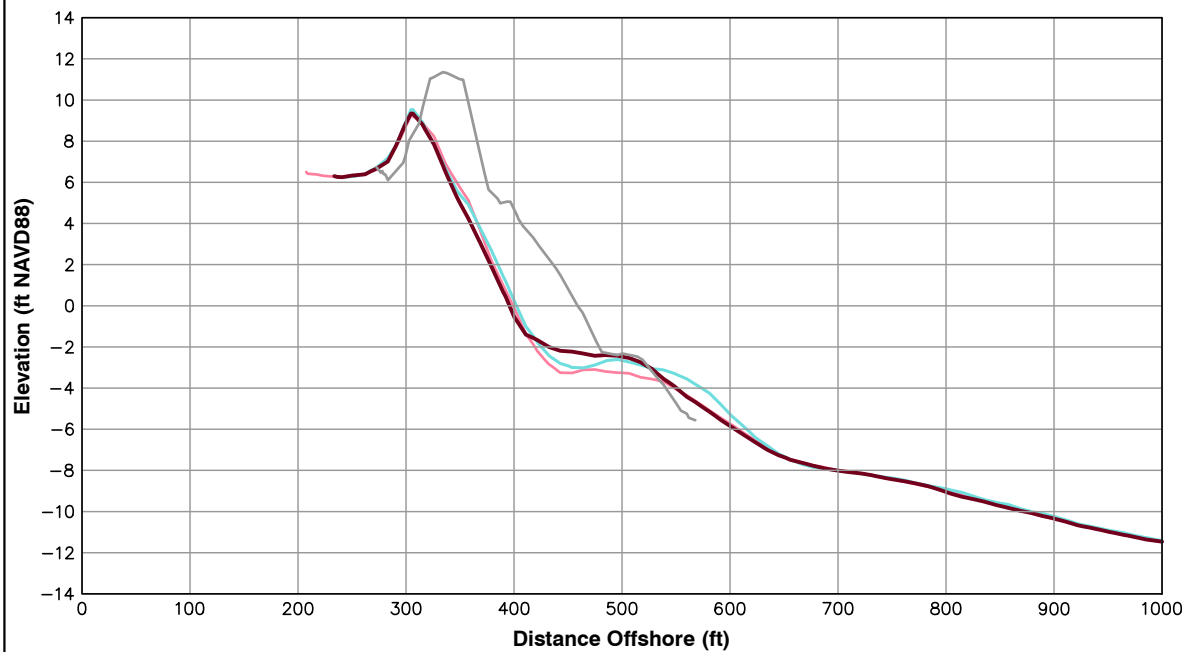
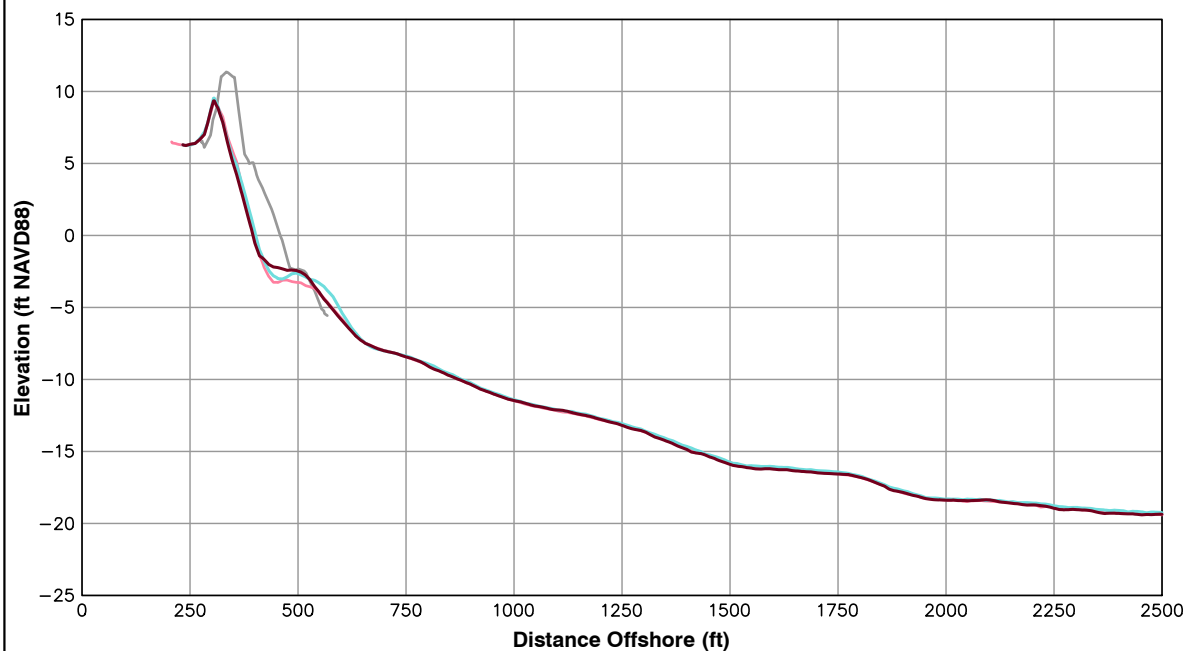
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 57+57**

**Pg 26 of 106**

**Fall 2013**





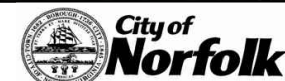
Survey Transect 59+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-2.78 ft/yr	-6.74 ft
Volume Change Above -15 ft NAVD88	1.17 cy/ft/yr	-5.15 cy/ft
Volume Change Above 0 ft NAVD88	-1.31 cy/ft/yr	-1.64 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

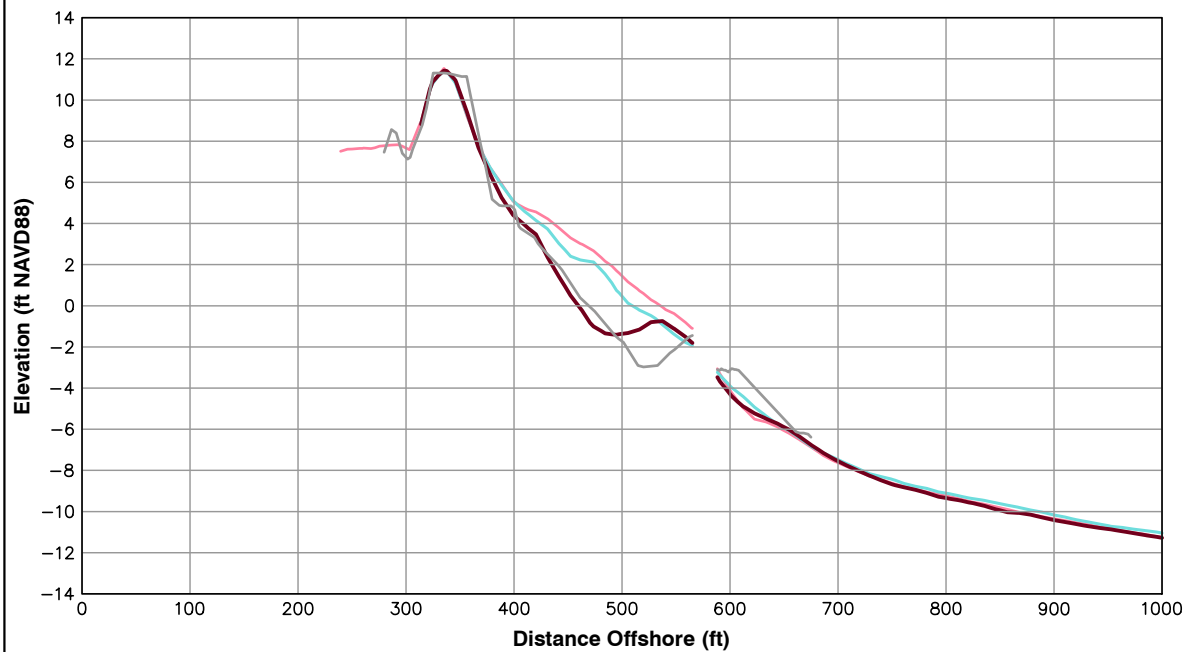
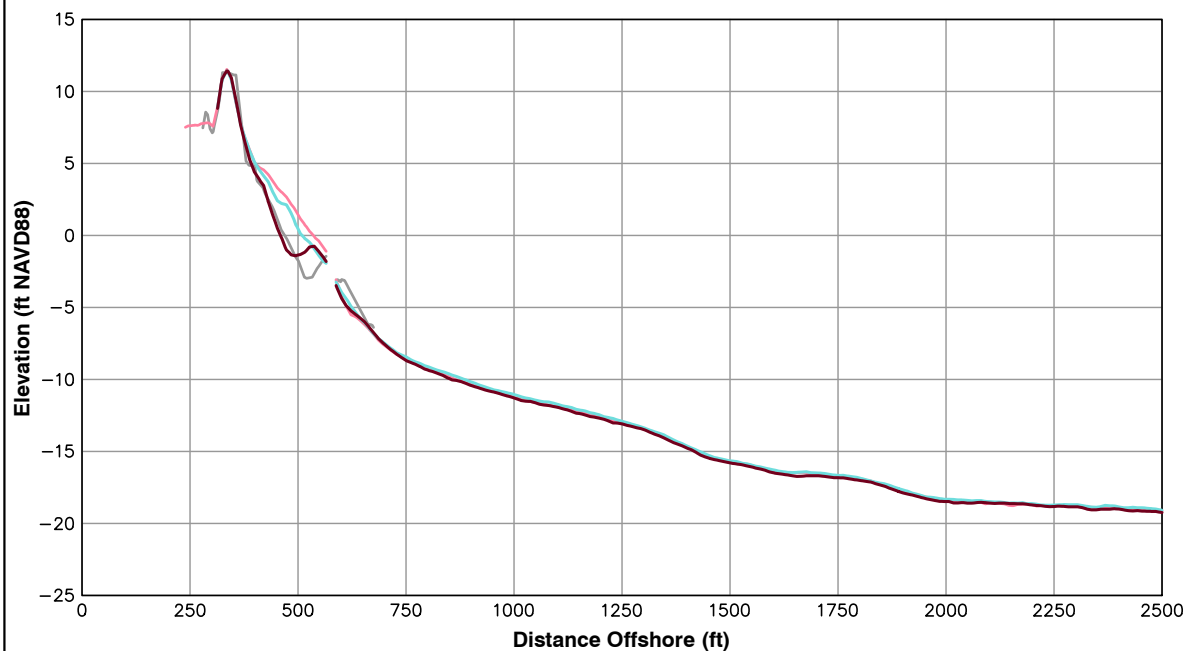


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 59+62**

**Pg 27 of 106**

**Fall 2013**



Survey Transect 61+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-59.91 ft/yr	-45.33 ft
Volume Change Above -15 ft NAVD88	-13.07 cy/ft/yr	-14.08 cy/ft
Volume Change Above 0 ft NAVD88	-8.31 cy/ft/yr	-5.69 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



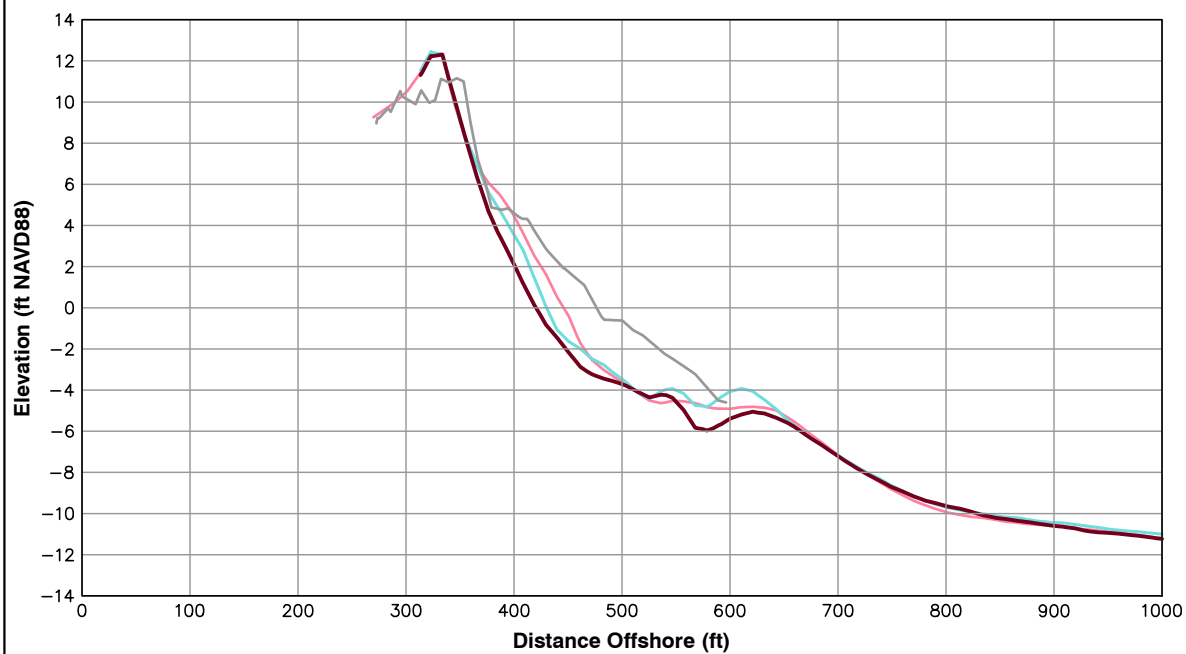
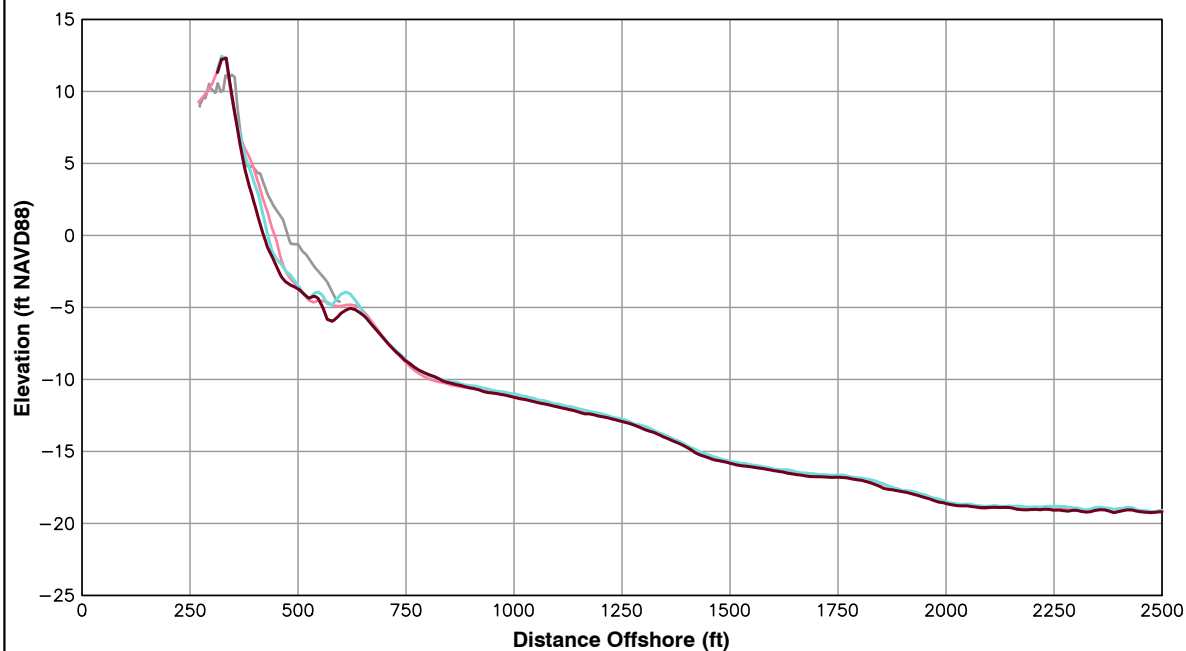
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 61+62**

**Pg 28 of 106**

**Fall 2013**





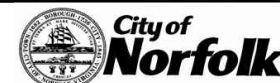
Survey Transect 63+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-23.77 ft/yr	-11.99 ft
Volume Change Above -15 ft NAVD88	-9.78 cy/ft/yr	-12.46 cy/ft
Volume Change Above 0 ft NAVD88	-4.87 cy/ft/yr	-2.93 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

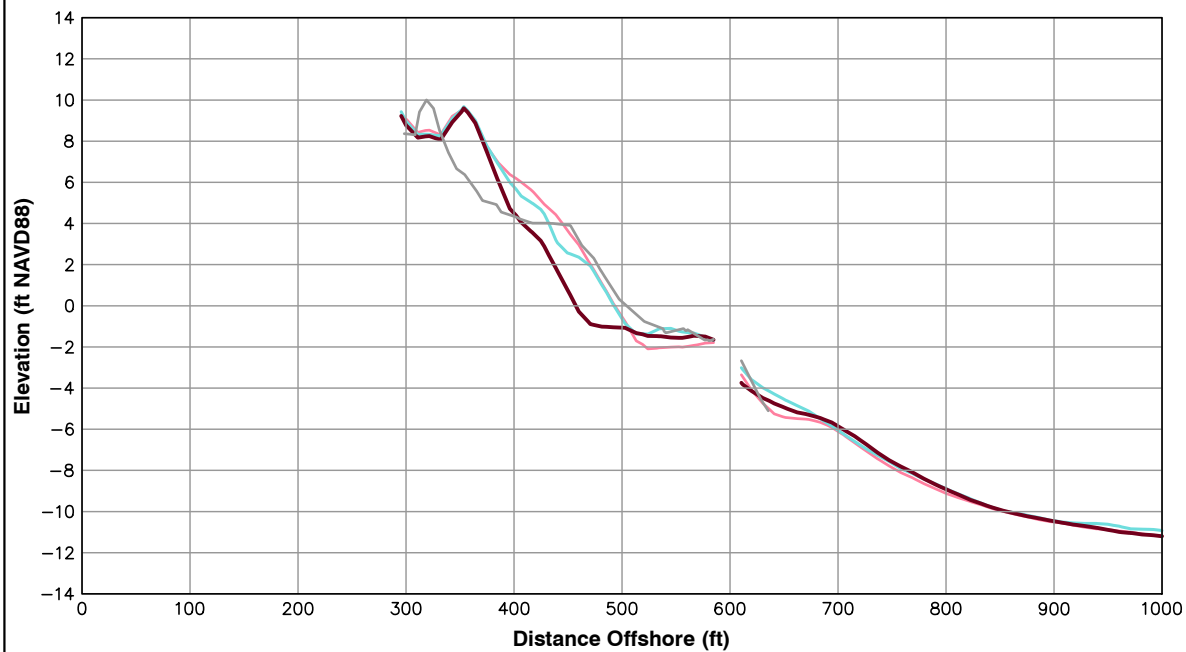
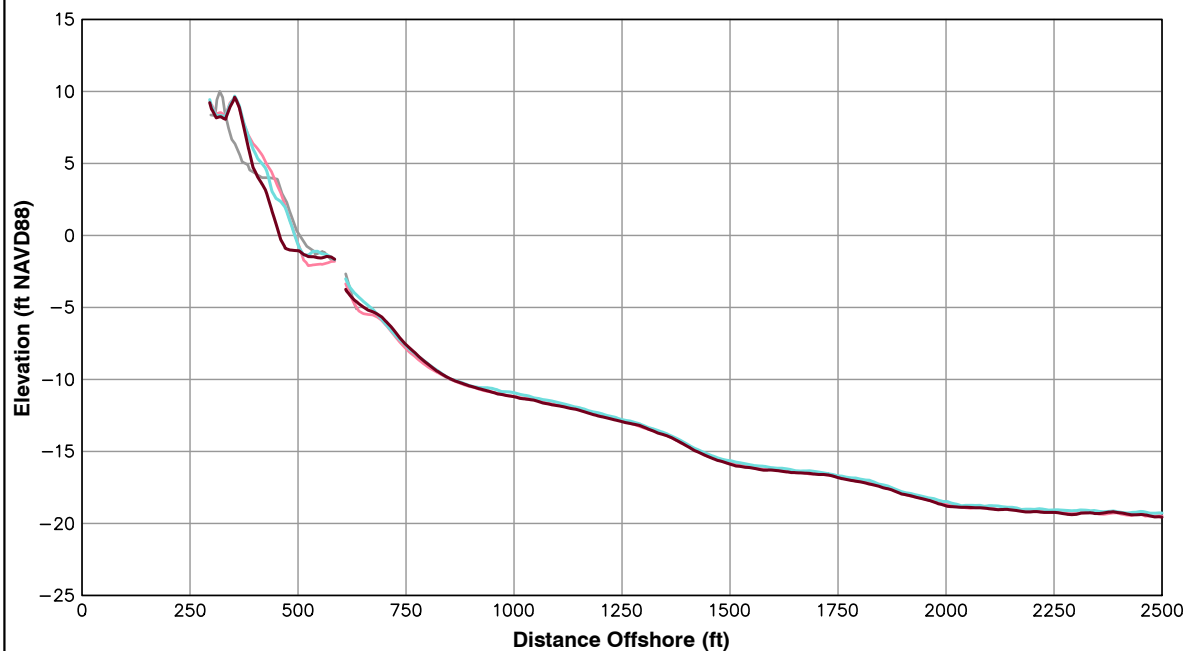


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 63+62**

**Pg 29 of 106**

**Fall 2013**



Survey Transect 65+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-33.10 ft/yr	-34.18 ft
Volume Change Above -15 ft NAVD88	-6.77 cy/ft/yr	-12.41 cy/ft
Volume Change Above 0 ft NAVD88	-8.10 cy/ft/yr	-6.41 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



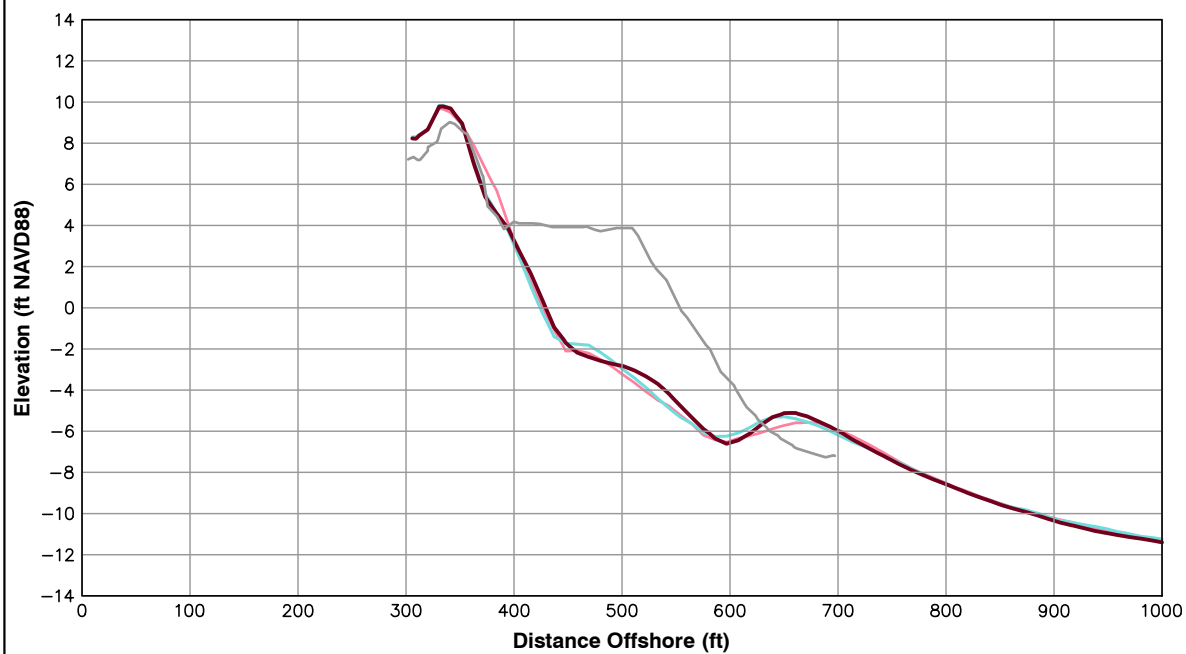
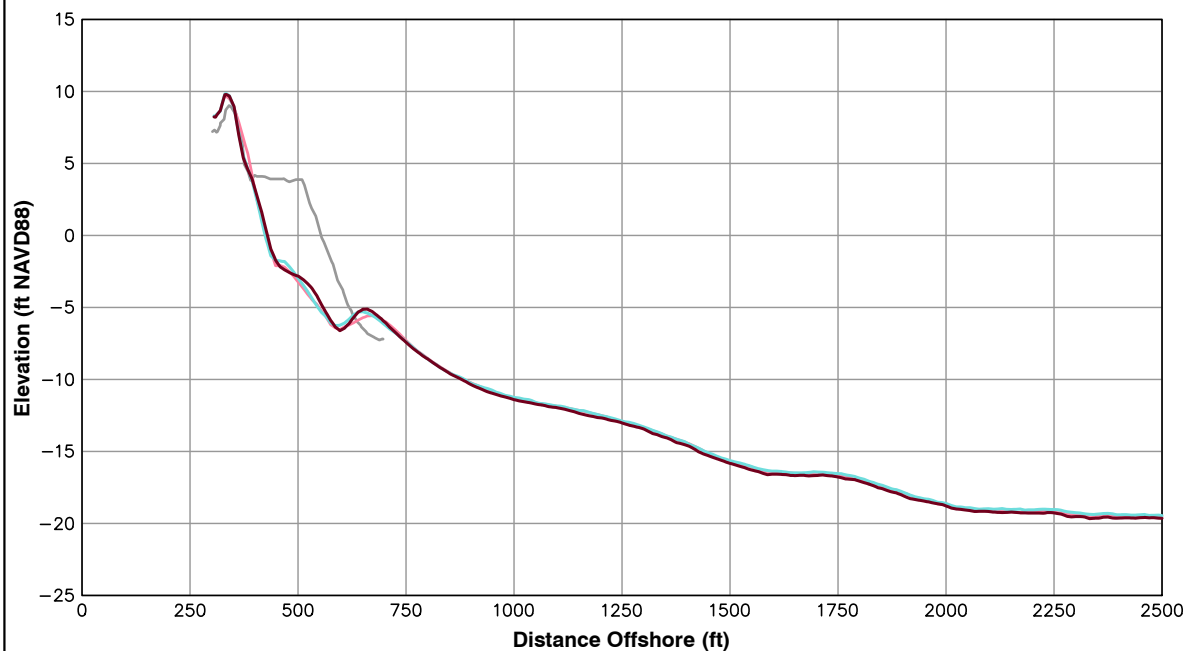
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 65+62**

**Pg 30 of 106**

**Fall 2013**





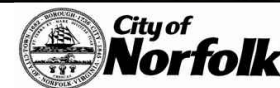
Survey Transect 67+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	3.22 ft/yr	5.15 ft
Volume Change Above -15 ft NAVD88	-1.38 cy/ft/yr	-2.08 cy/ft
Volume Change Above 0 ft NAVD88	-0.89 cy/ft/yr	0.40 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

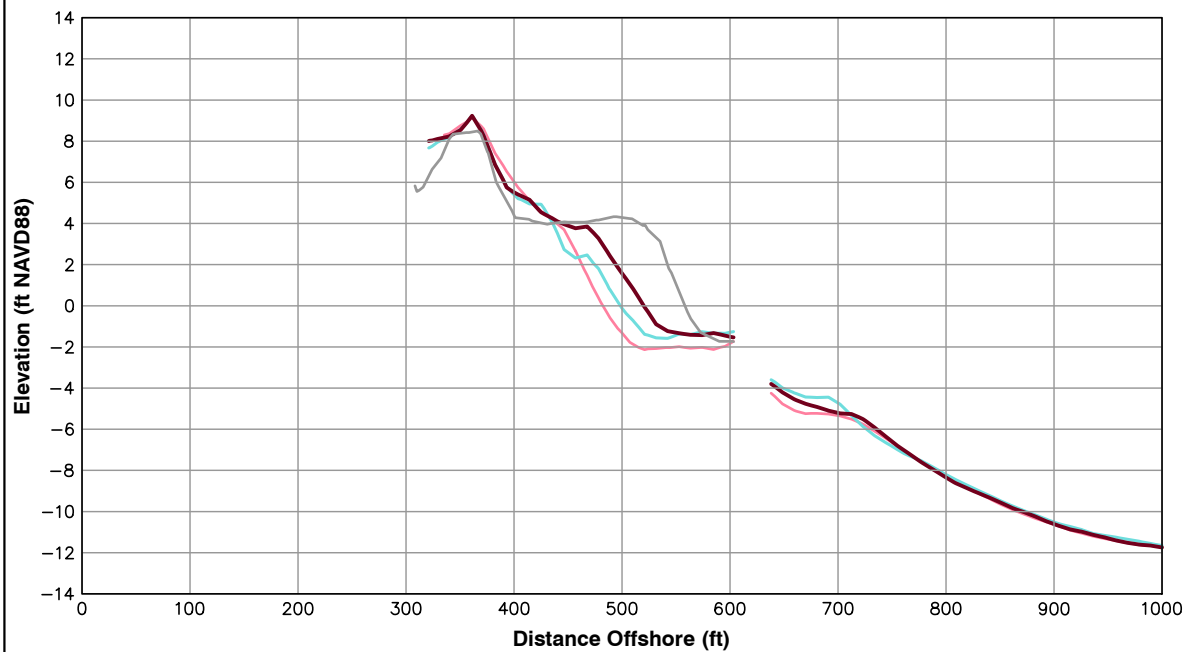
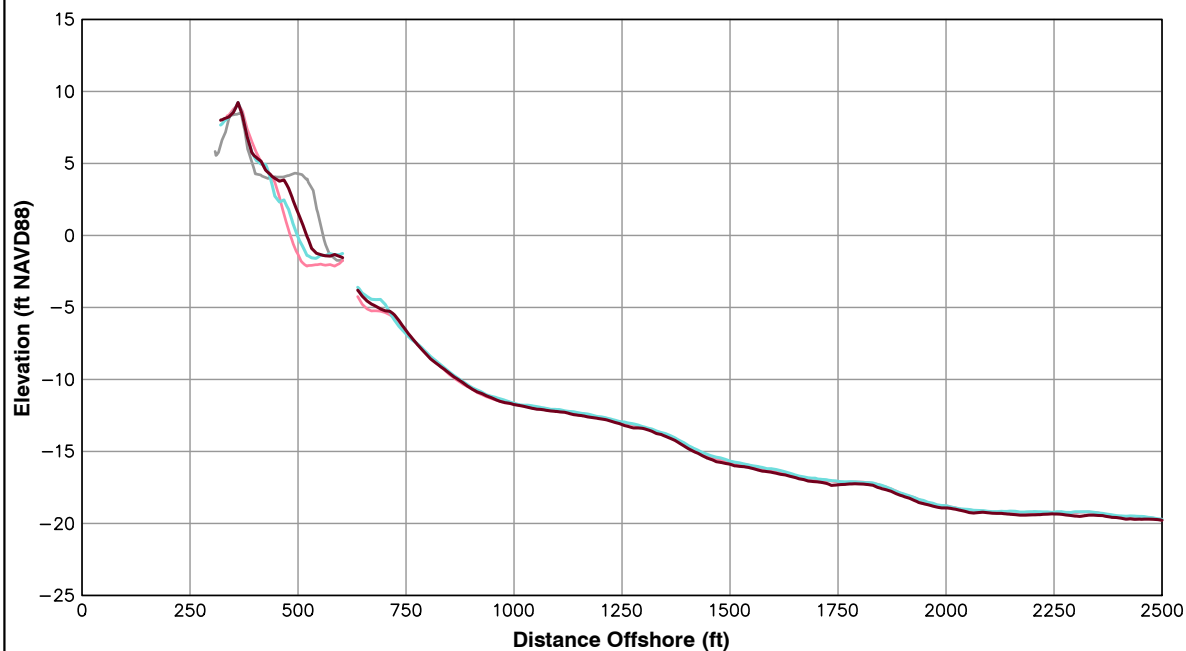


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 67+62**

**Pg 31 of 106**

**Fall 2013**



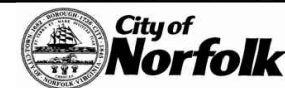
Survey Transect 69+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	33.96 ft/yr	21.36 ft
Volume Change Above -15 ft NAVD88	7.59 cy/ft/yr	1.12 cy/ft
Volume Change Above 0 ft NAVD88	3.49 cy/ft/yr	3.93 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

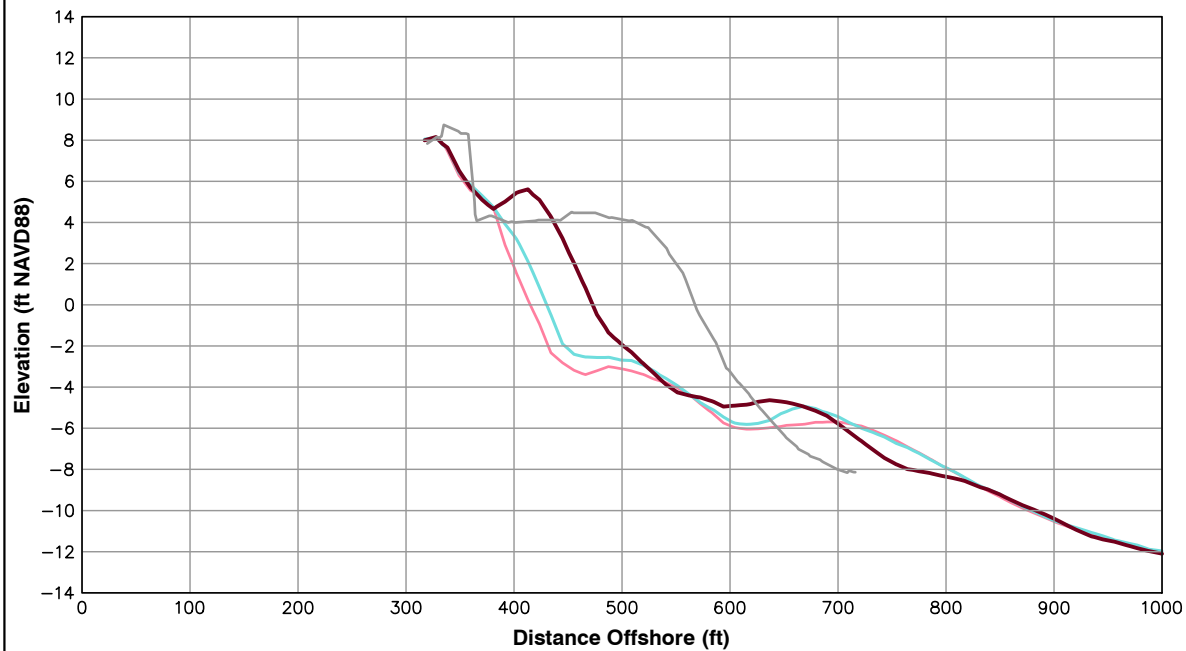
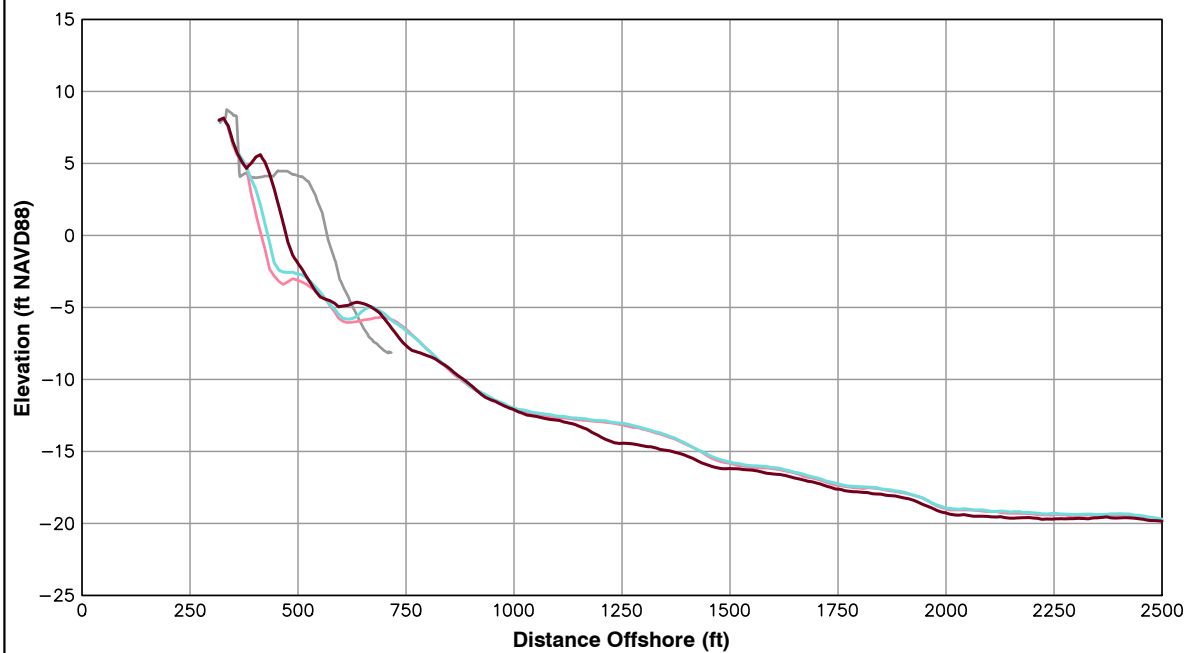


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 69+62**

**Pg 32 of 106**

**Fall 2013**



Survey Transect 71+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	54.68 ft/yr	42.30 ft
Volume Change Above -15 ft NAVD88	8.50 cy/ft/yr	-0.51 cy/ft
Volume Change Above 0 ft NAVD88	10.08 cy/ft/yr	8.33 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



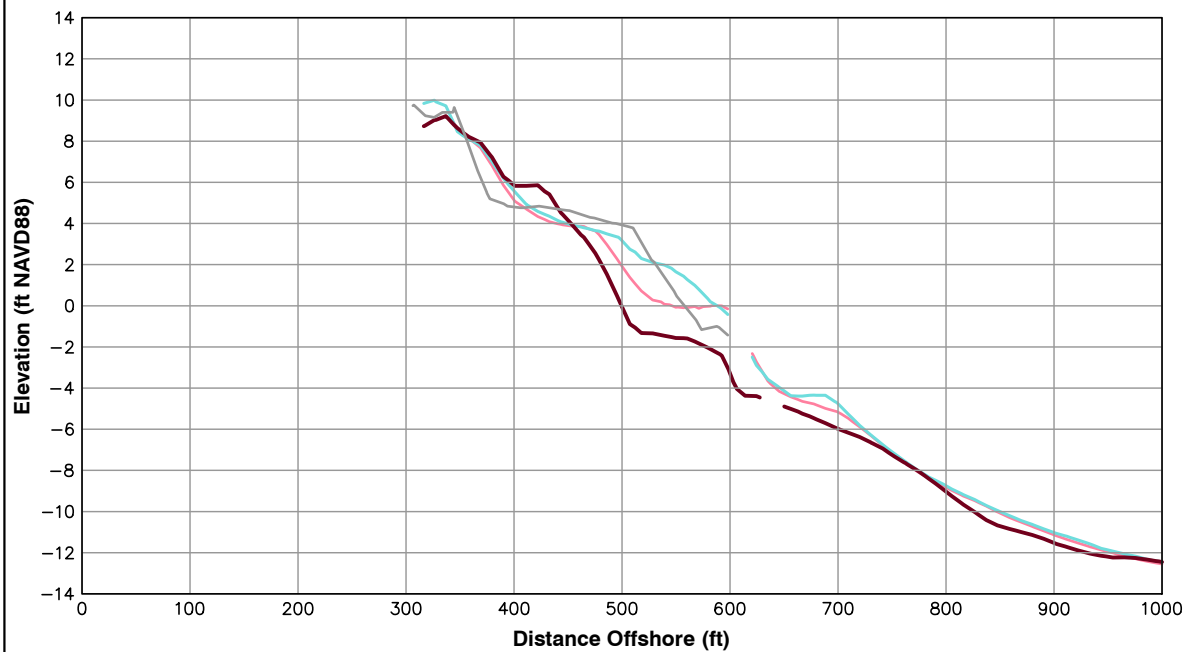
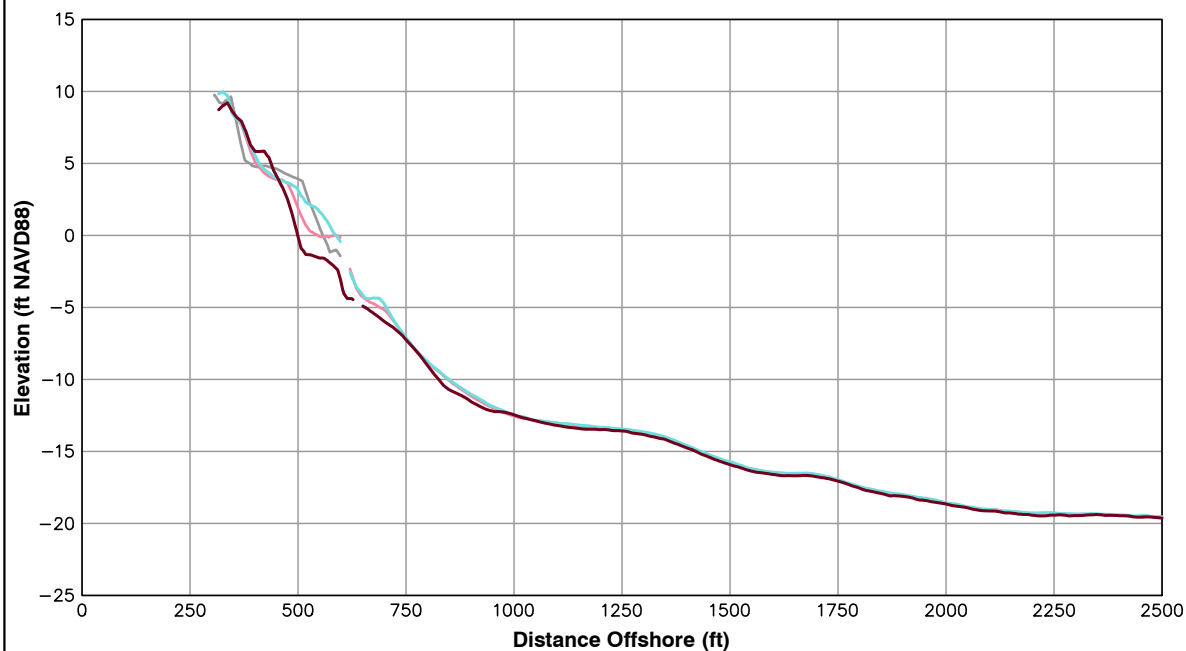
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 71+62**

**Pg 33 of 106**

**Fall 2013**





Survey Transect 73+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-21.49 ft/yr	-76.60 ft
Volume Change Above -15 ft NAVD88	-11.77 cy/ft/yr	-21.59 cy/ft
Volume Change Above 0 ft NAVD88	-0.39 cy/ft/yr	-6.71 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

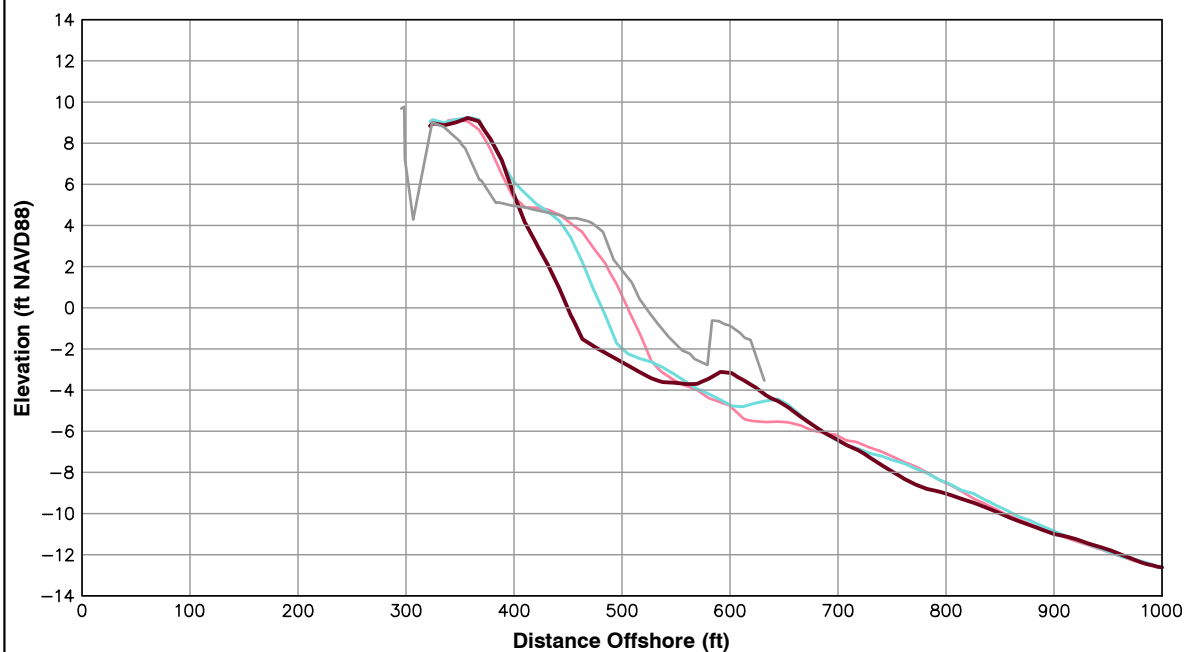
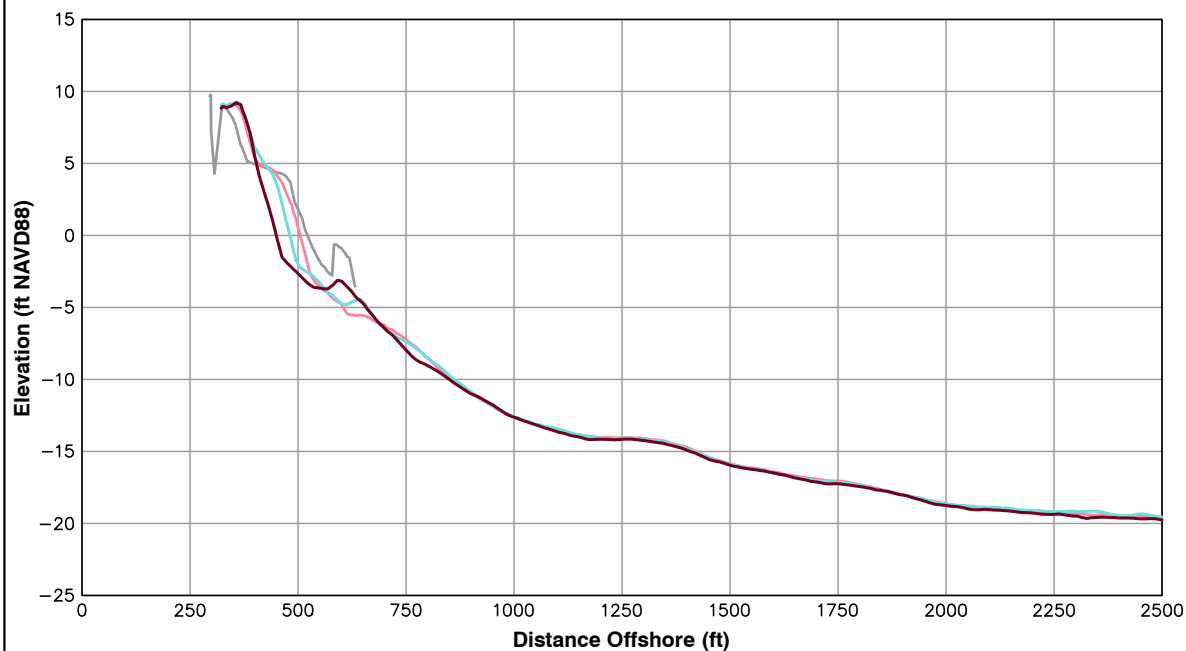


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 73+62**

**Pg 34 of 106**

**Fall 2013**



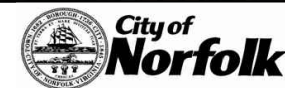
Survey Transect 75+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-51.96 ft/yr	-31.34 ft
Volume Change Above -15 ft NAVD88	-13.28 cy/ft/yr	-6.56 cy/ft
Volume Change Above 0 ft NAVD88	-7.84 cy/ft/yr	-6.56 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

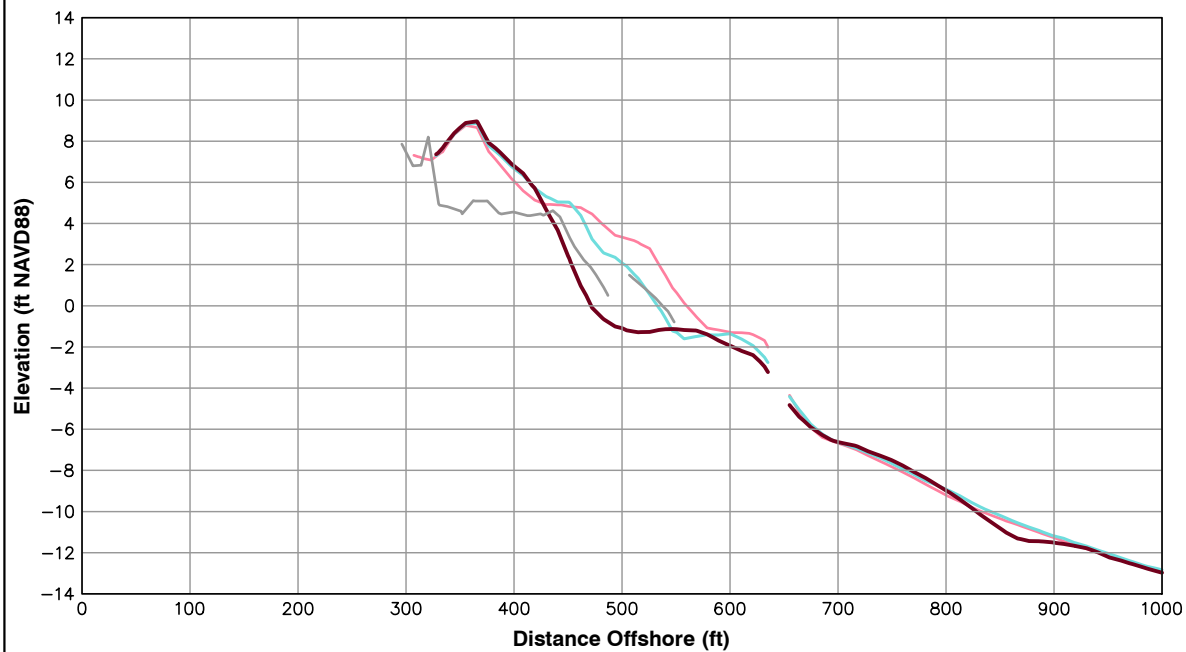
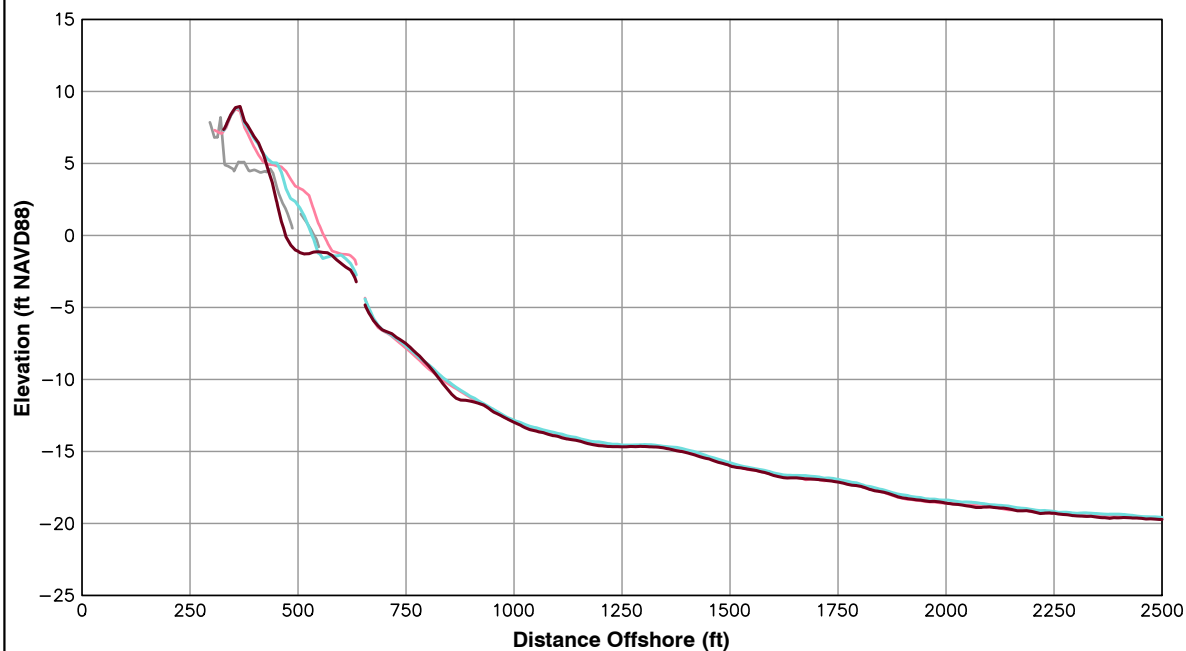


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 75+62**

**Pg 35 of 106**

**Fall 2013**



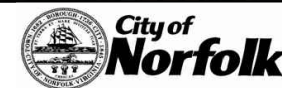
Survey Transect 77+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-79.44 ft/yr	-58.10 ft
Volume Change Above -15 ft NAVD88	-17.04 cy/ft/yr	-15.60 cy/ft
Volume Change Above 0 ft NAVD88	-10.35 cy/ft/yr	-7.62 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



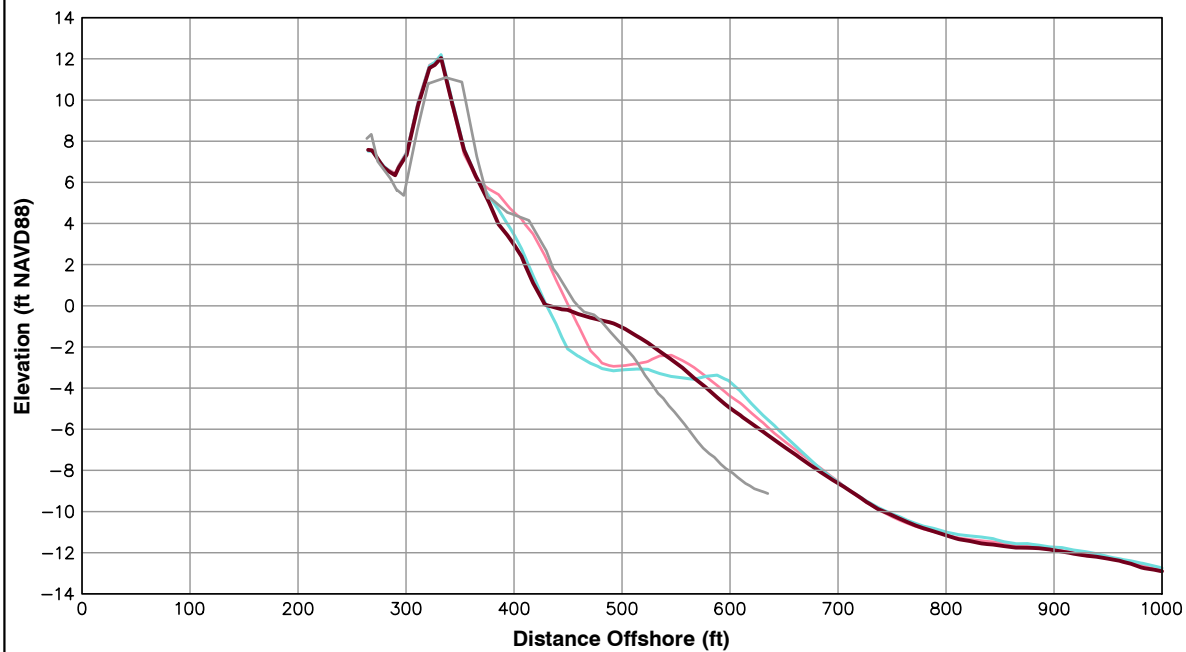
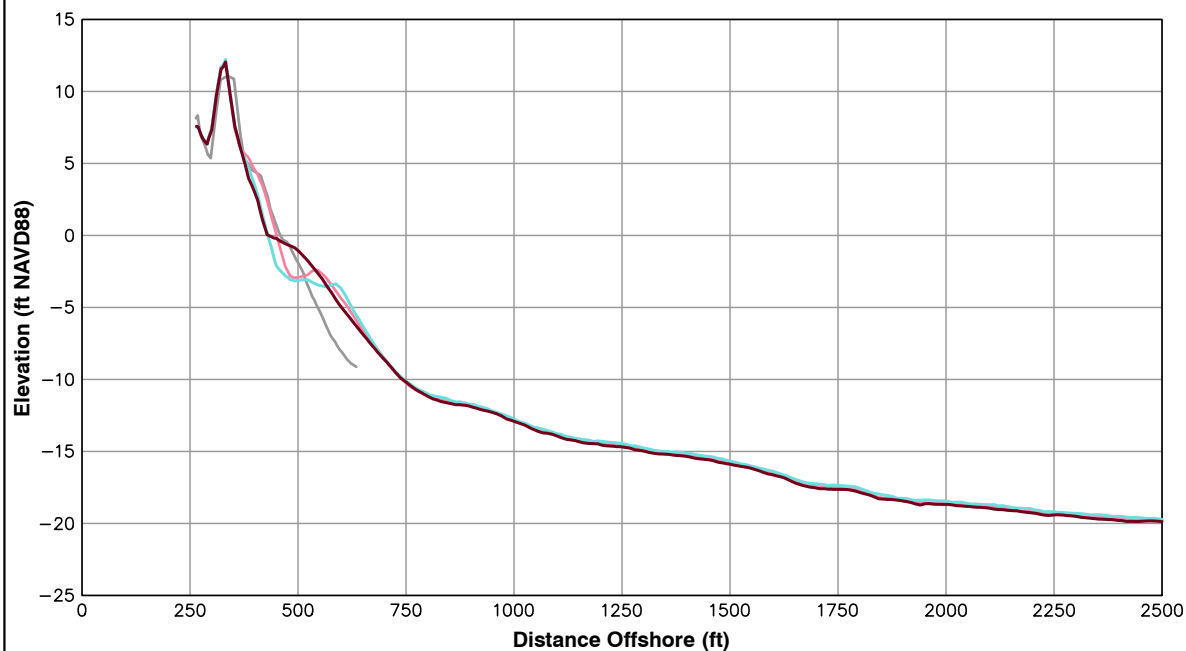
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 77+62

Pg 36 of 106

Fall 2013





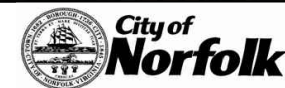
Survey Transect 79+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-21.23 ft/yr	-2.73 ft
Volume Change Above -15 ft NAVD88	-4.25 cy/ft/yr	-0.95 cy/ft
Volume Change Above 0 ft NAVD88	-4.32 cy/ft/yr	-1.19 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

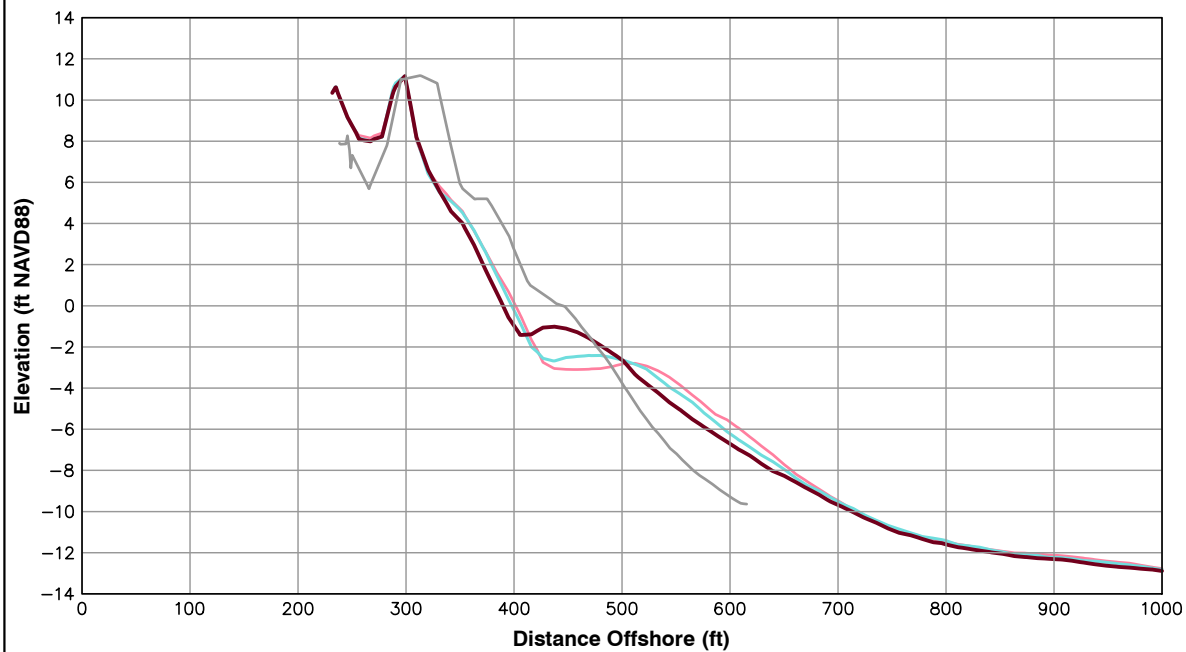
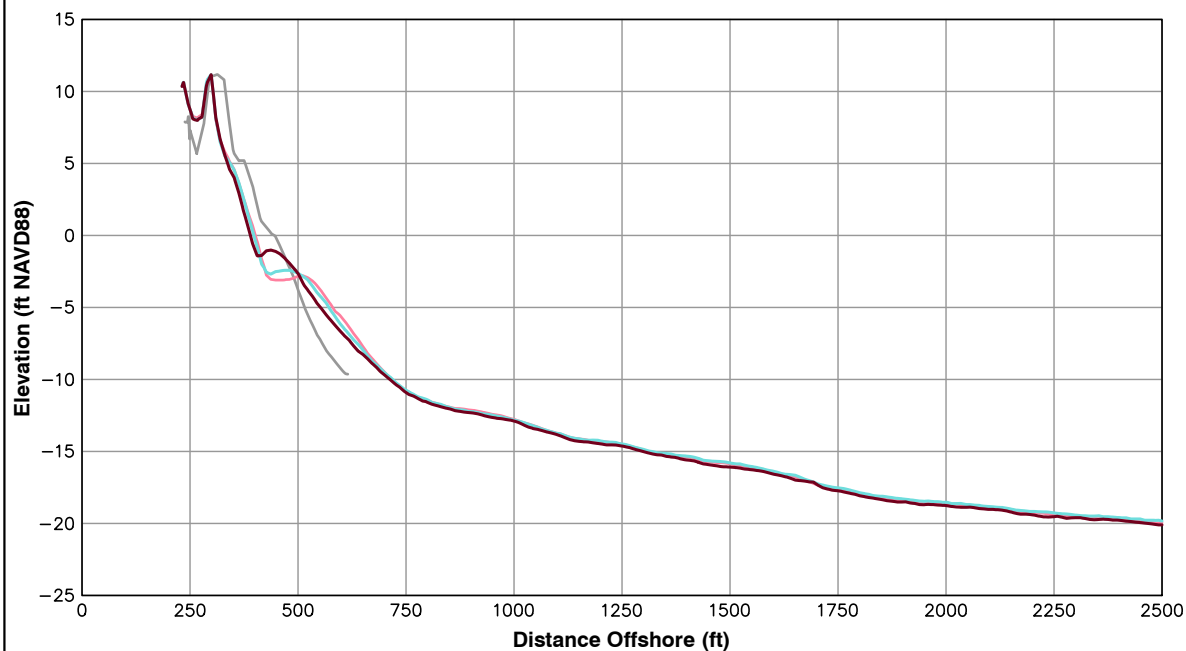


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 79+62**

**Pg 37 of 106**

**Fall 2013**



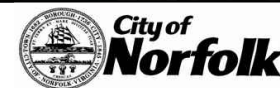
Survey Transect 81+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-10.13 ft/yr	-7.93 ft
Volume Change Above -15 ft NAVD88	-6.80 cy/ft/yr	-5.48 cy/ft
Volume Change Above 0 ft NAVD88	-1.79 cy/ft/yr	-1.47 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

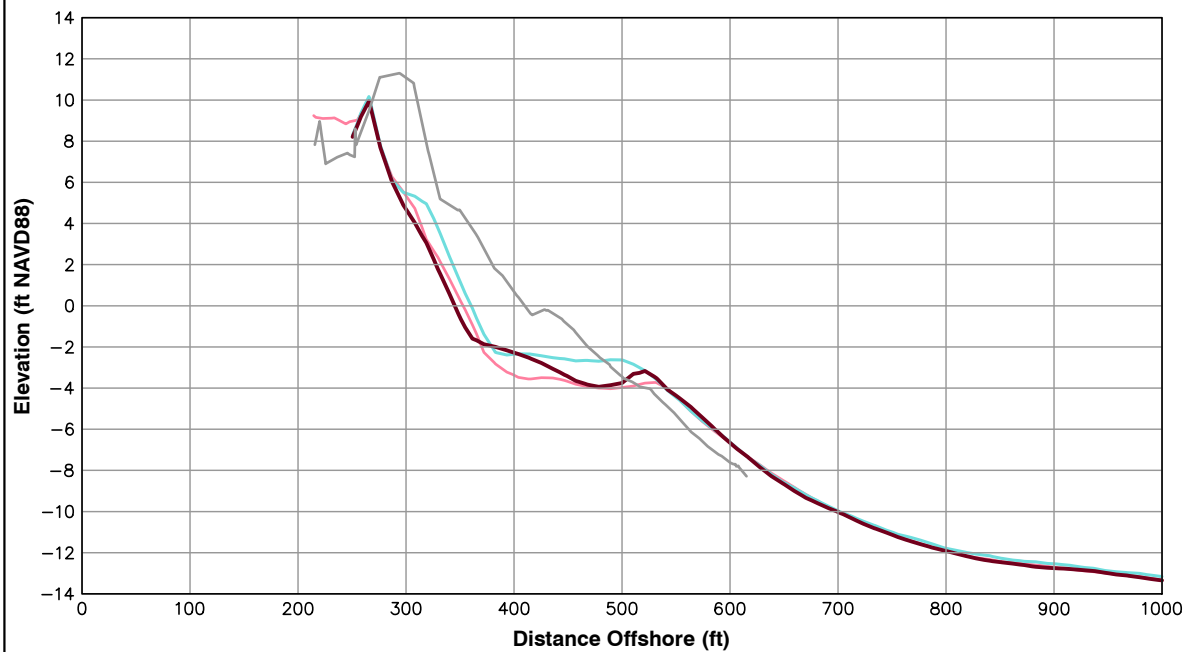
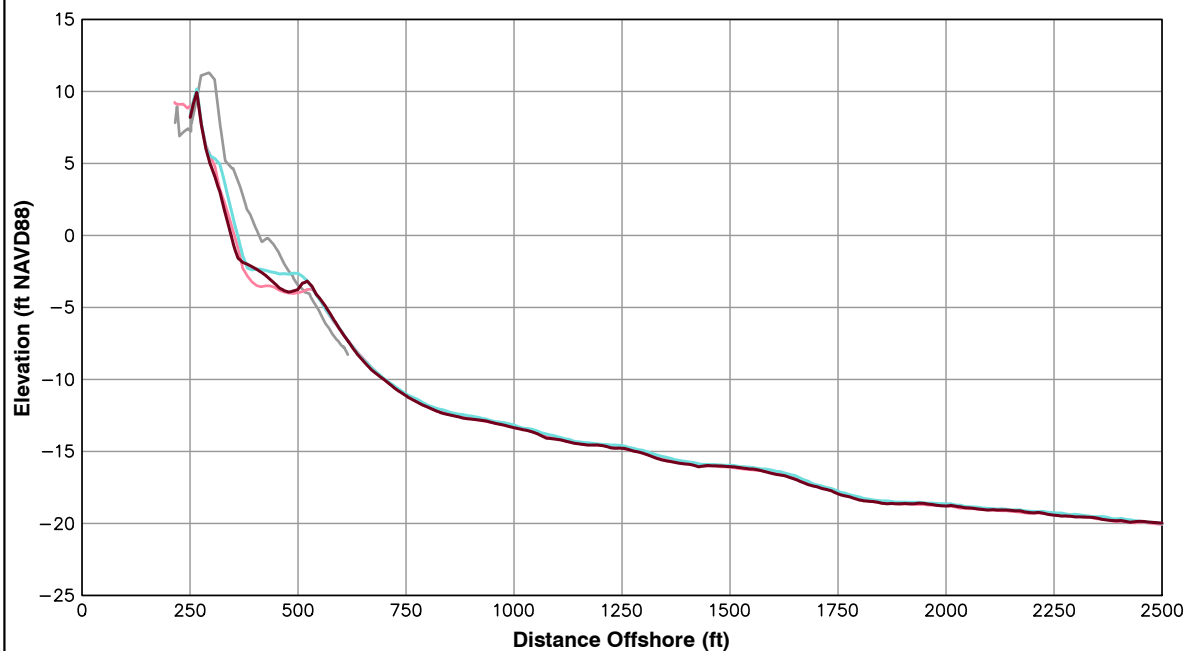


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 81+62**

**Pg 38 of 106**

**Fall 2013**



Survey Transect 83+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-6.26 ft/yr	-14.98 ft
Volume Change Above -15 ft NAVD88	0.38 cy/ft/yr	-11.39 cy/ft
Volume Change Above 0 ft NAVD88	-1.38 cy/ft/yr	-3.69 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



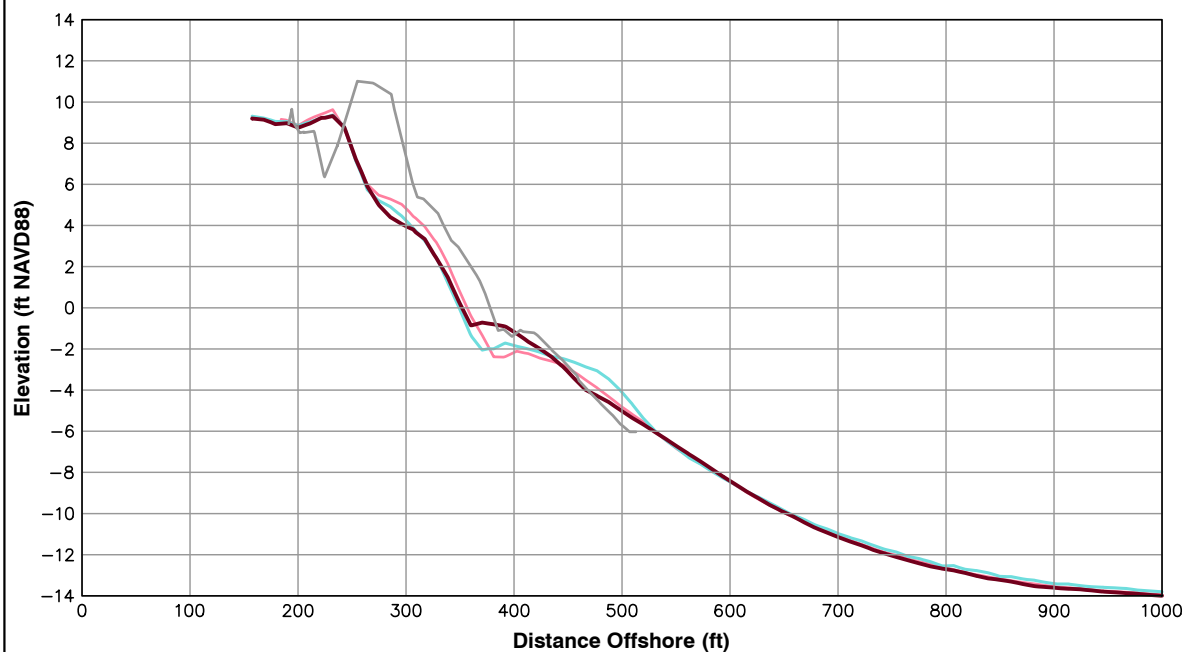
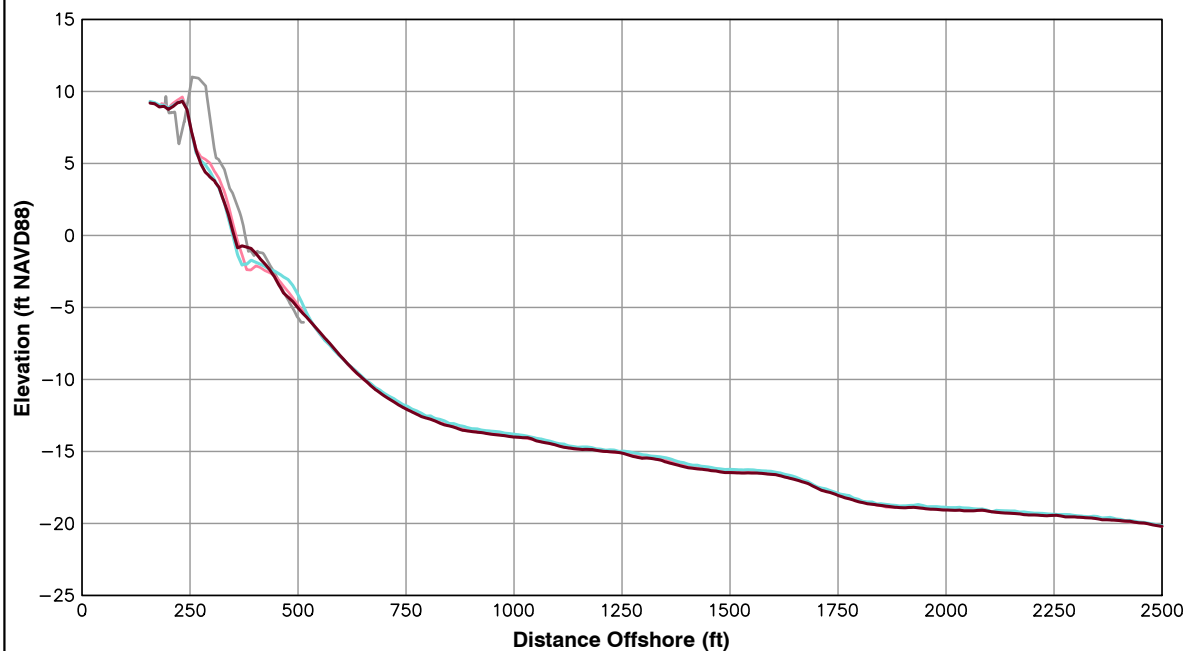
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 83+62**

**Pg 39 of 106**

**Fall 2013**





Survey Transect 85+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-4.85 ft/yr	2.26 ft
Volume Change Above -15 ft NAVD88	-1.76 cy/ft/yr	-4.77 cy/ft
Volume Change Above 0 ft NAVD88	-2.45 cy/ft/yr	-0.41 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



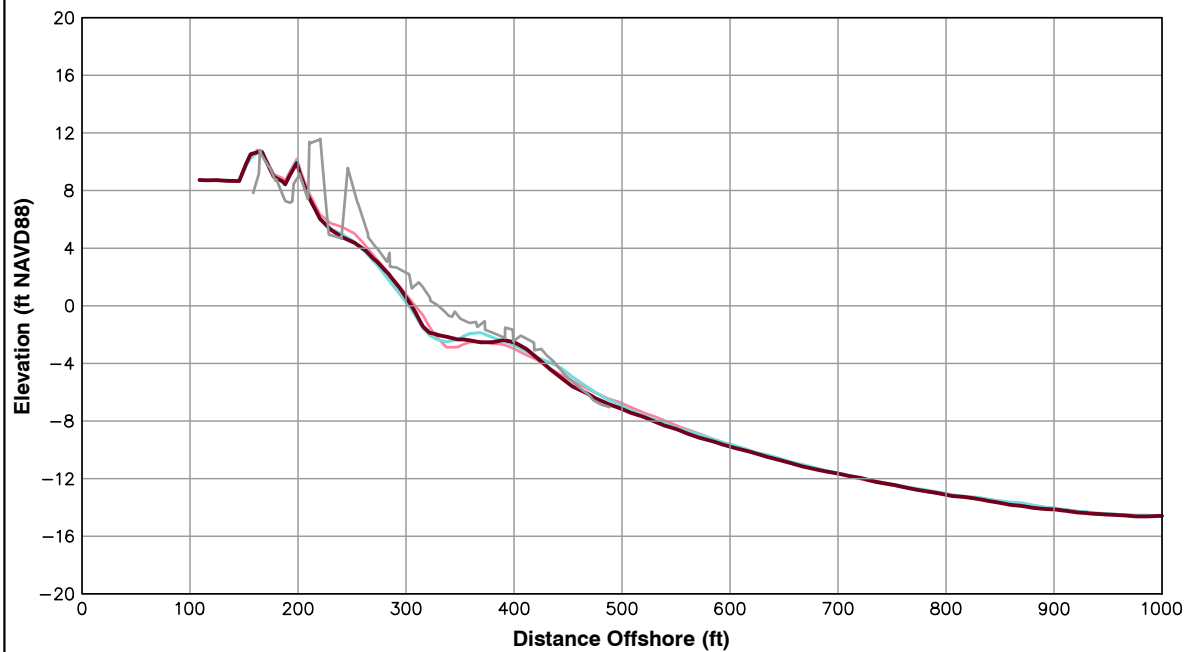
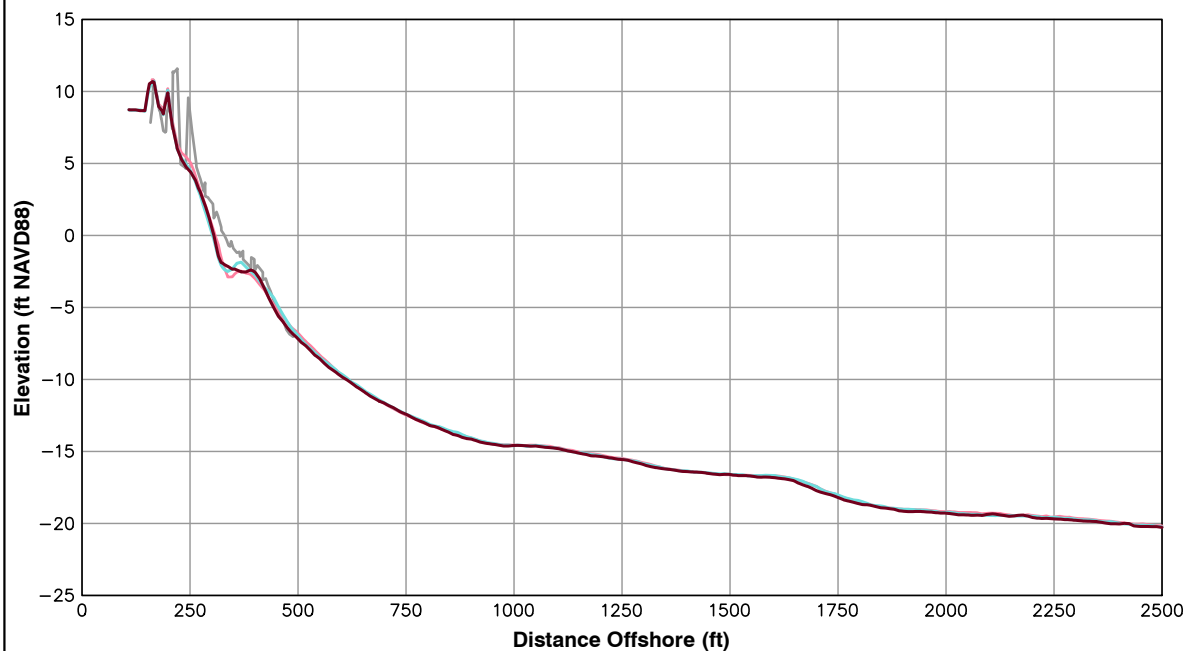
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 85+62**

**Pg 40 of 106**

**Fall 2013**



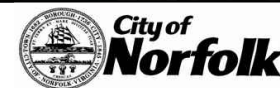
Survey Transect 87+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.31 ft/yr	3.99 ft
Volume Change Above -15 ft NAVD88	-3.27 cy/ft/yr	-2.88 cy/ft
Volume Change Above 0 ft NAVD88	-1.54 cy/ft/yr	0.36 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

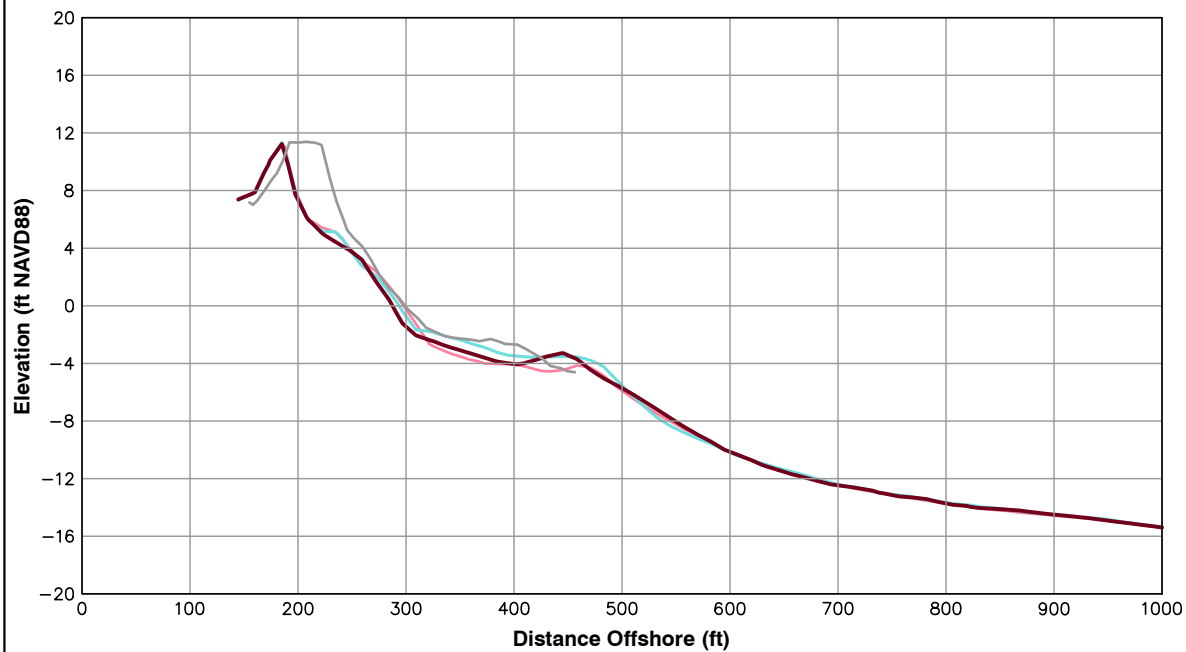
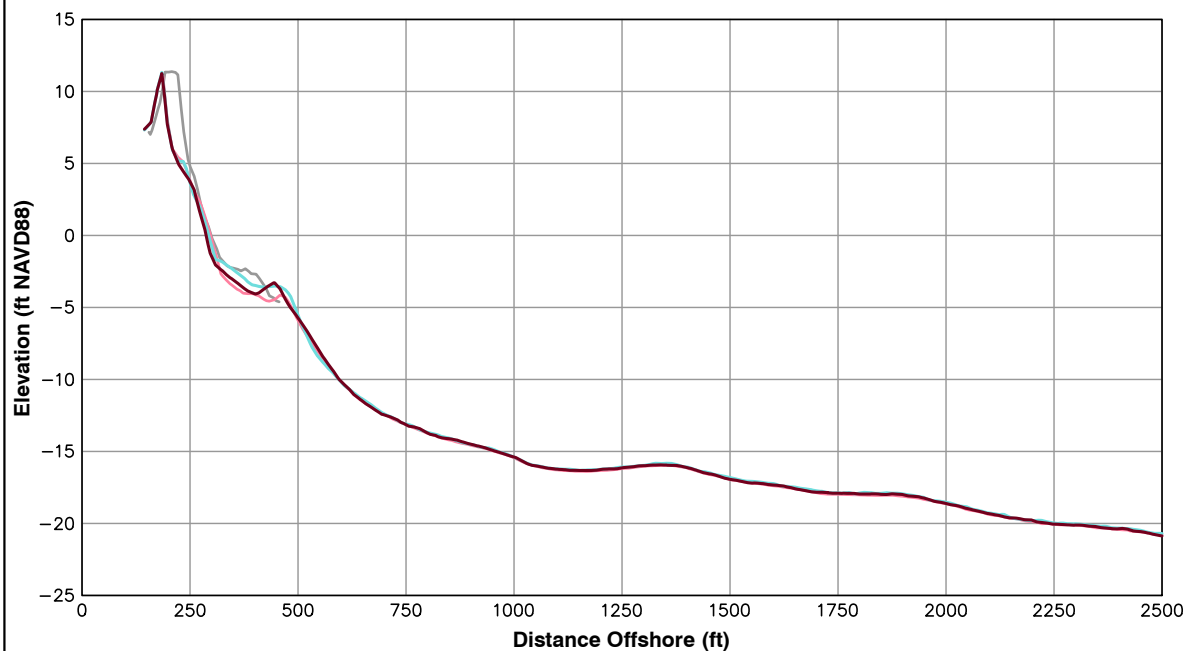


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 87+62**

**Pg 41 of 106**

**Fall 2013**



Survey Transect 93+41	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-8.84 ft/yr	-5.29 ft
Volume Change Above -15 ft NAVD88	1.23 cy/ft/yr	-4.01 cy/ft
Volume Change Above 0 ft NAVD88	-1.50 cy/ft/yr	-0.78 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

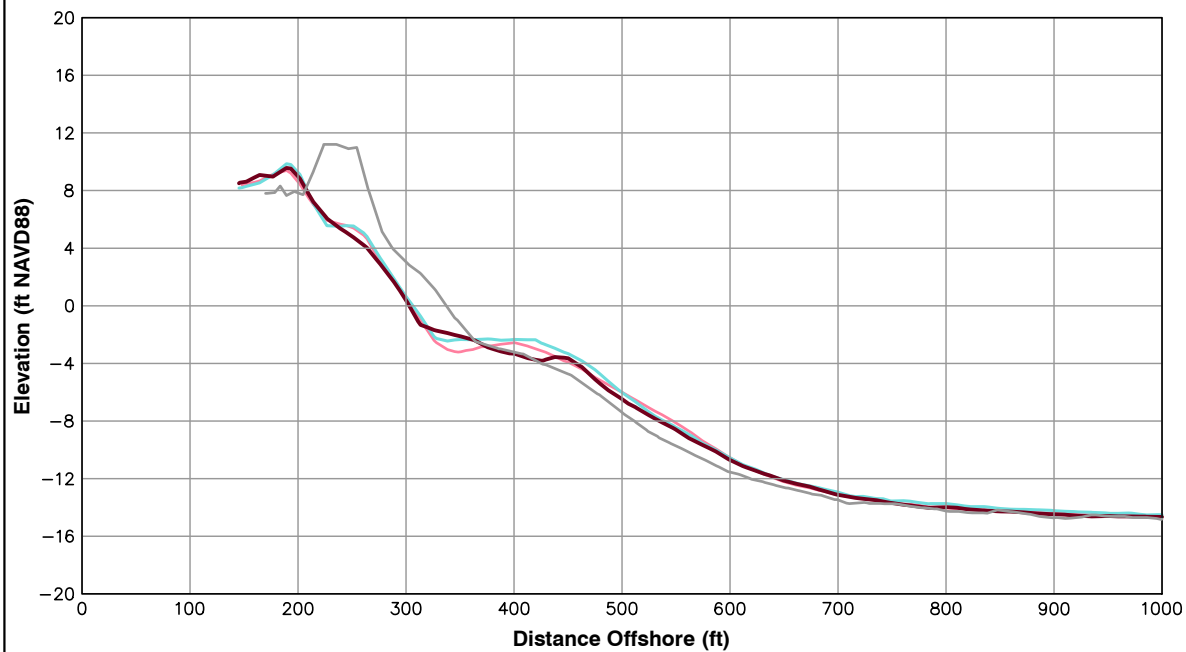
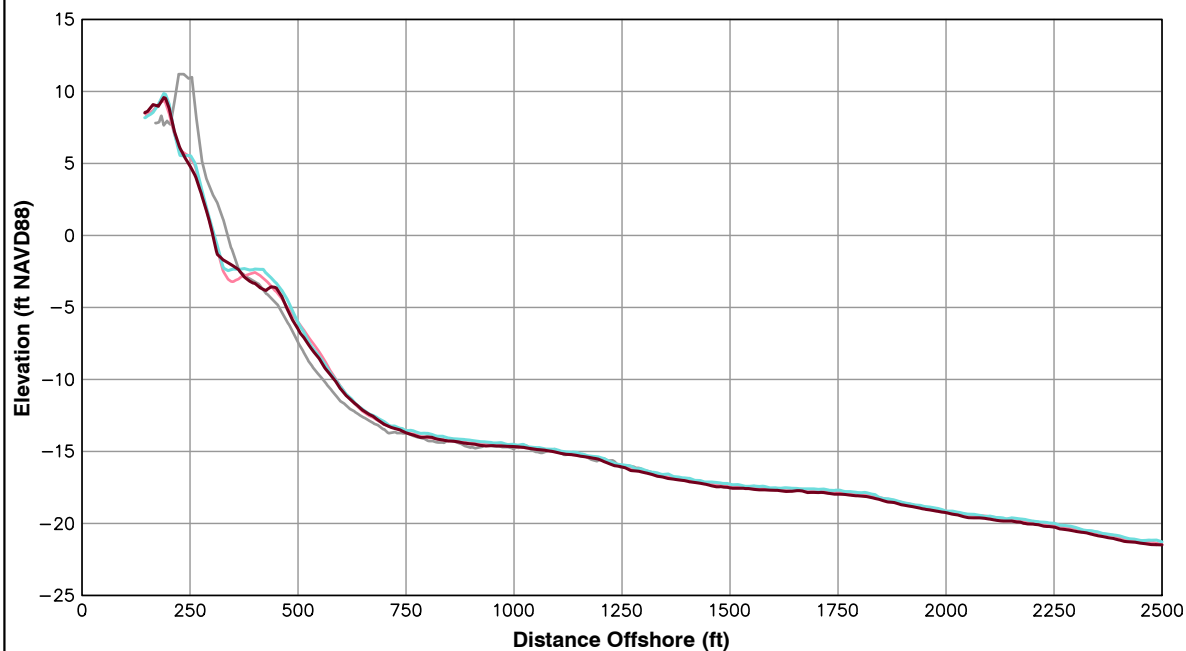
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 93+41**

**Pg 42 of 106**

**Fall 2013**





Survey Transect 103+08	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-0.32 ft/yr	-2.05 ft
Volume Change Above -15 ft NAVD88	-2.02 cy/ft/yr	-8.13 cy/ft
Volume Change Above 0 ft NAVD88	-0.22 cy/ft/yr	-0.82 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

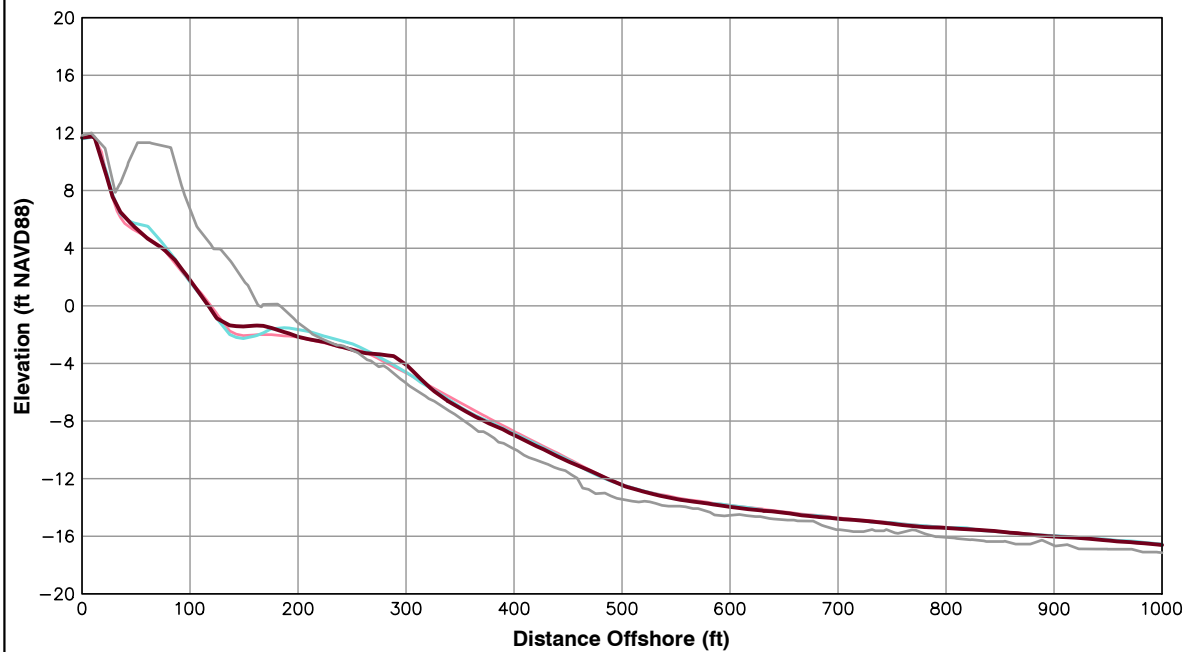
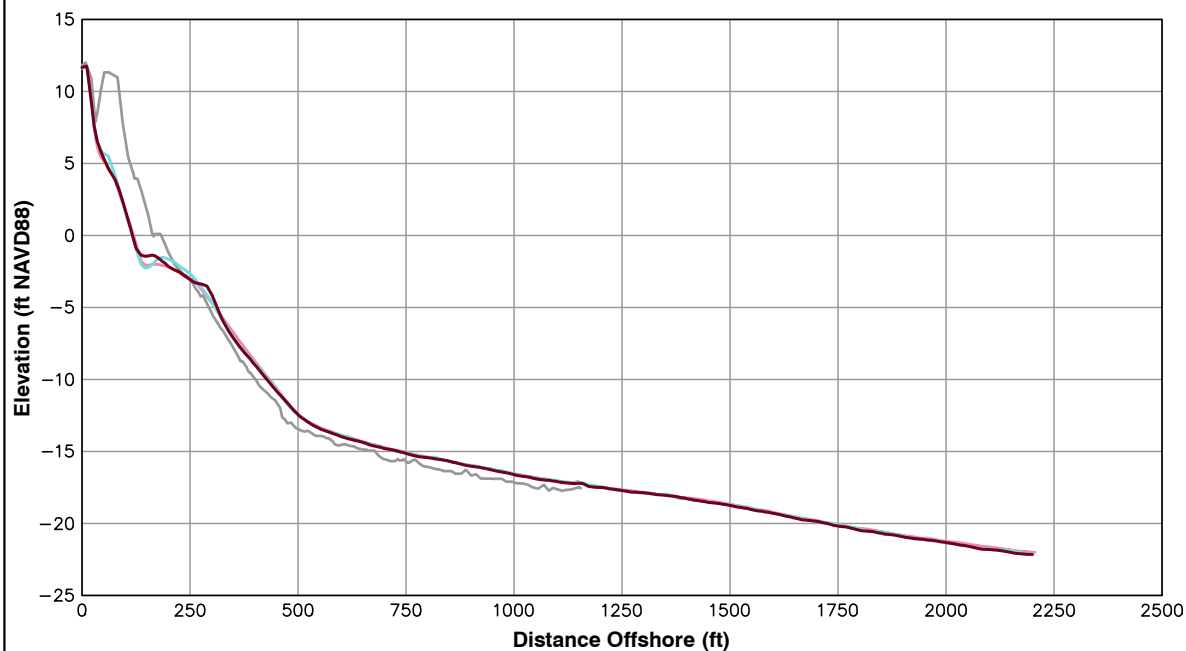


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 103+08**

**Pg 43 of 106**

**Fall 2013**



Survey Transect 120+93	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.27 ft/yr	0.58 ft
Volume Change Above -15 ft NAVD88	-0.13 cy/ft/yr	-0.99 cy/ft
Volume Change Above 0 ft NAVD88	0.20 cy/ft/yr	-0.69 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



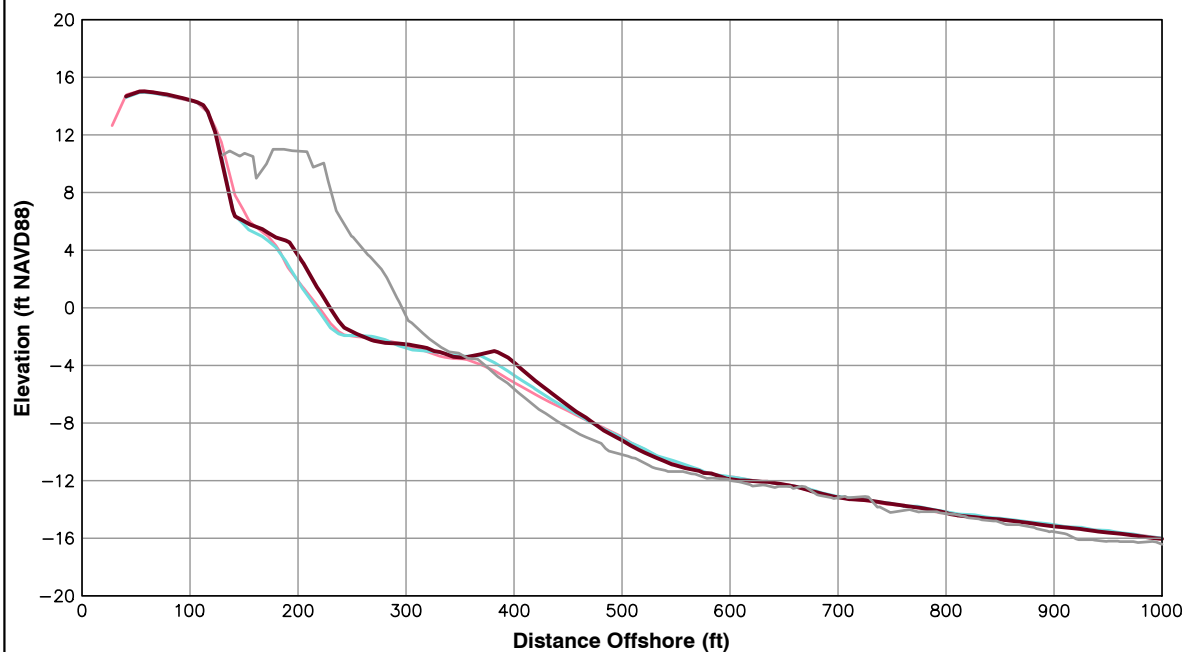
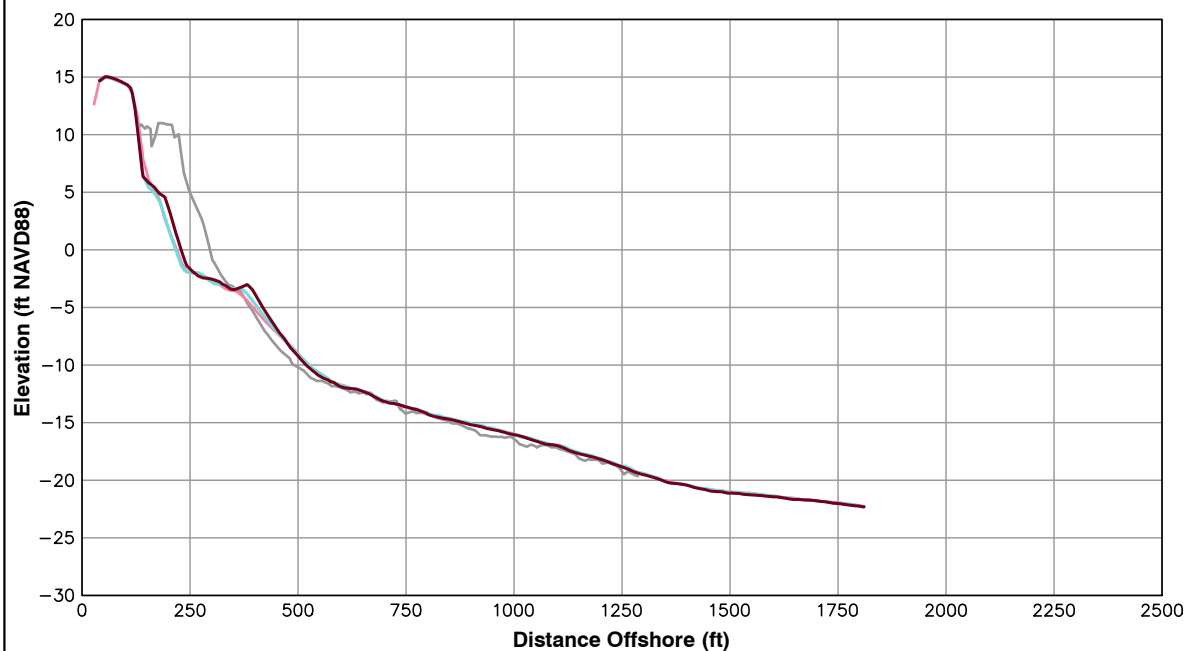
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 120+93

Pg 44 of 106

Fall 2013



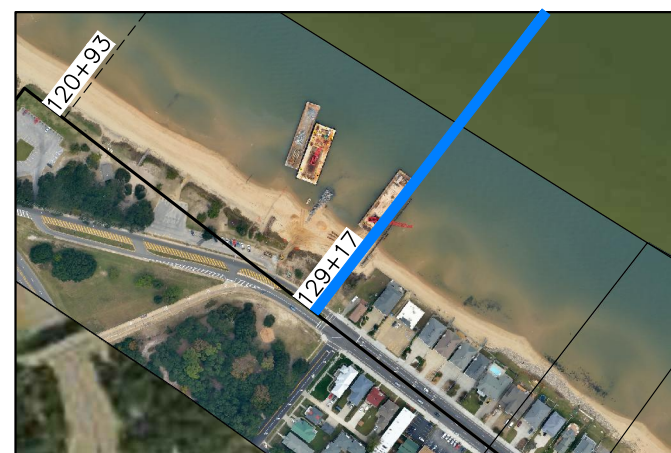
Survey Transect 129+17	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	11.73 ft/yr	14.03 ft
Volume Change Above -15 ft NAVD88	4.91 cy/ft/yr	4.69 cy/ft
Volume Change Above 0 ft NAVD88	1.32 cy/ft/yr	3.12 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



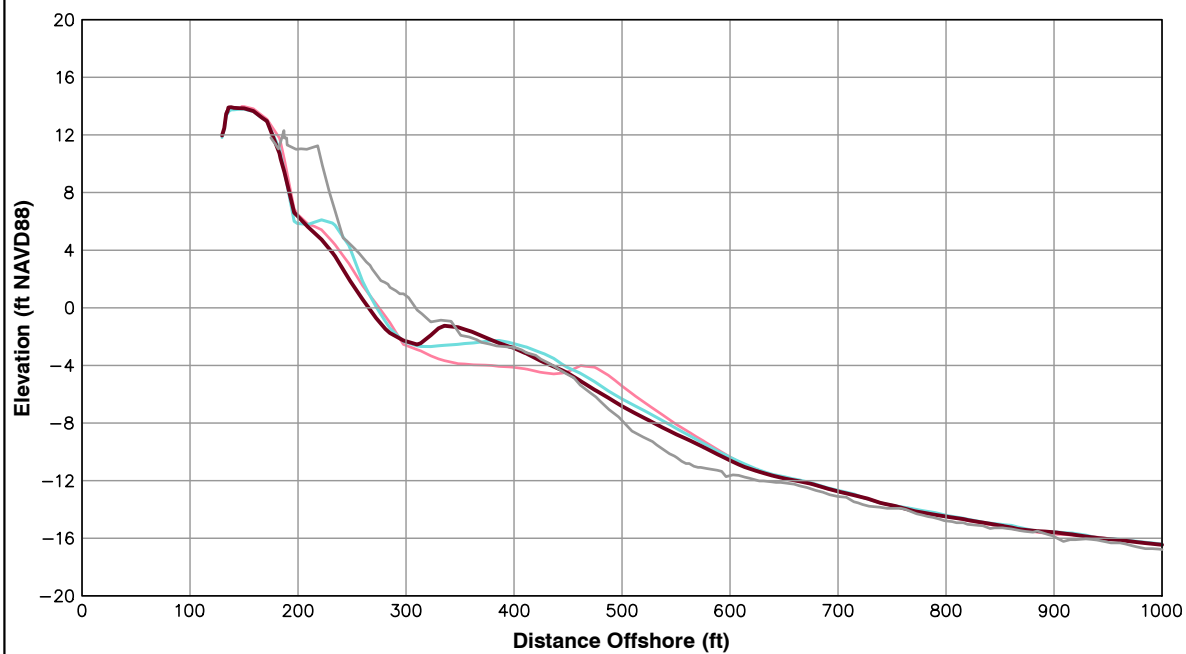
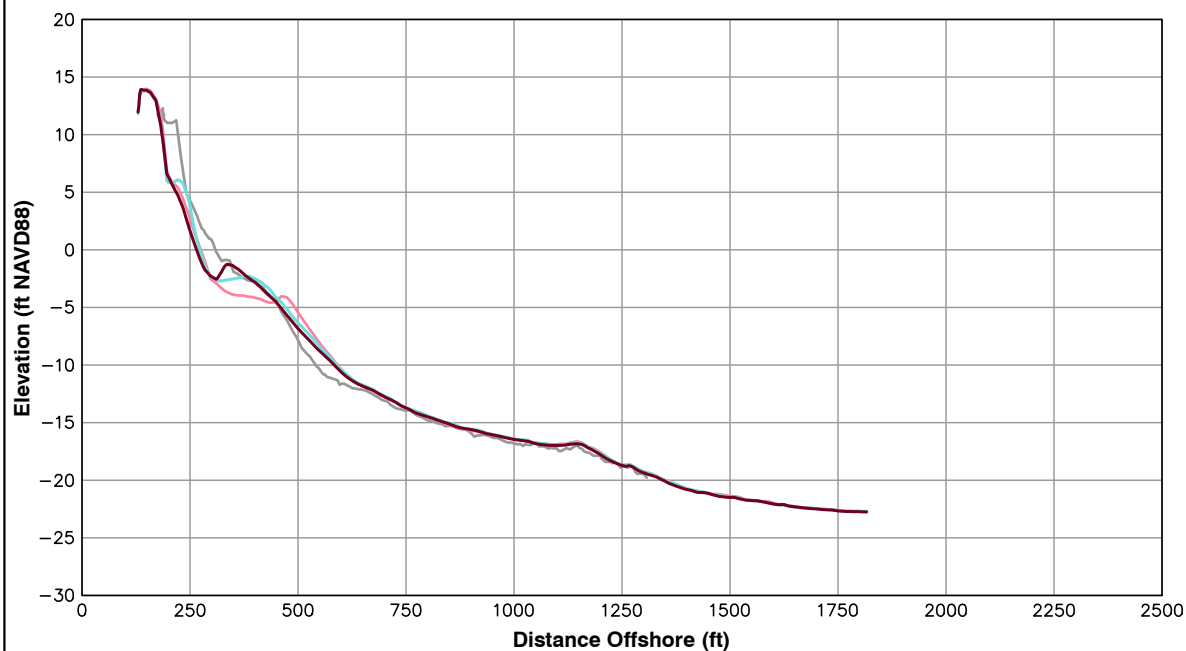
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 129+17

Pg 45 of 106

Fall 2013





Survey Transect 141+98	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-8.60 ft/yr	-9.35 ft
Volume Change Above -15 ft NAVD88	-0.81 cy/ft/yr	-5.70 cy/ft
Volume Change Above 0 ft NAVD88	-2.53 cy/ft/yr	-3.22 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

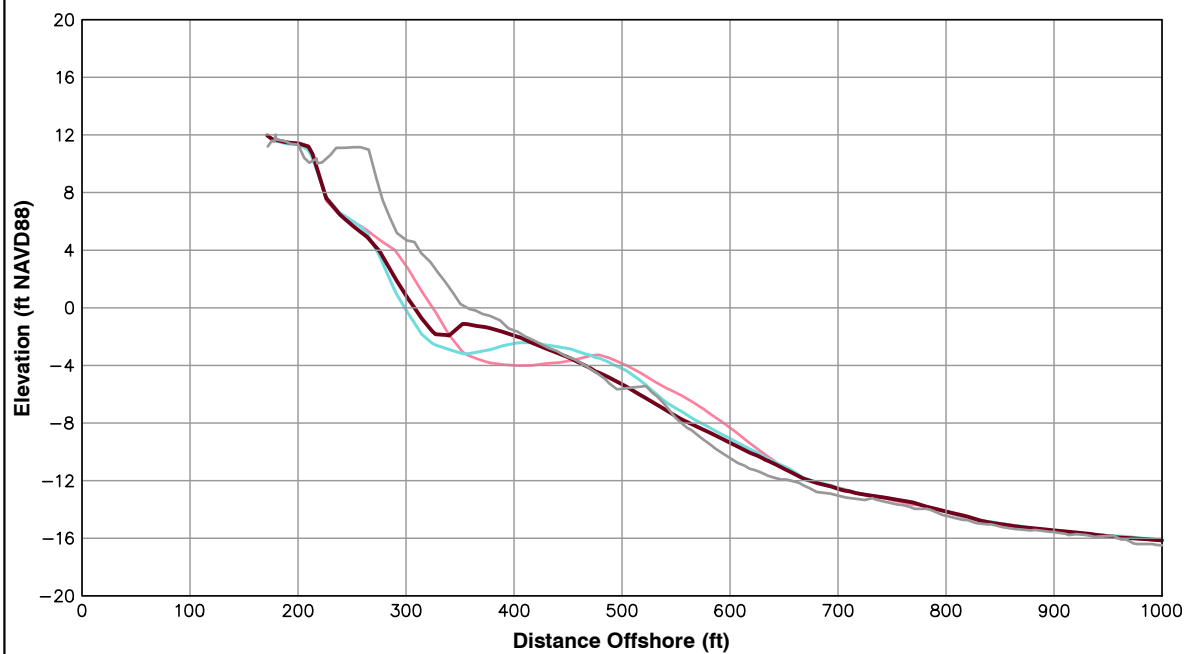
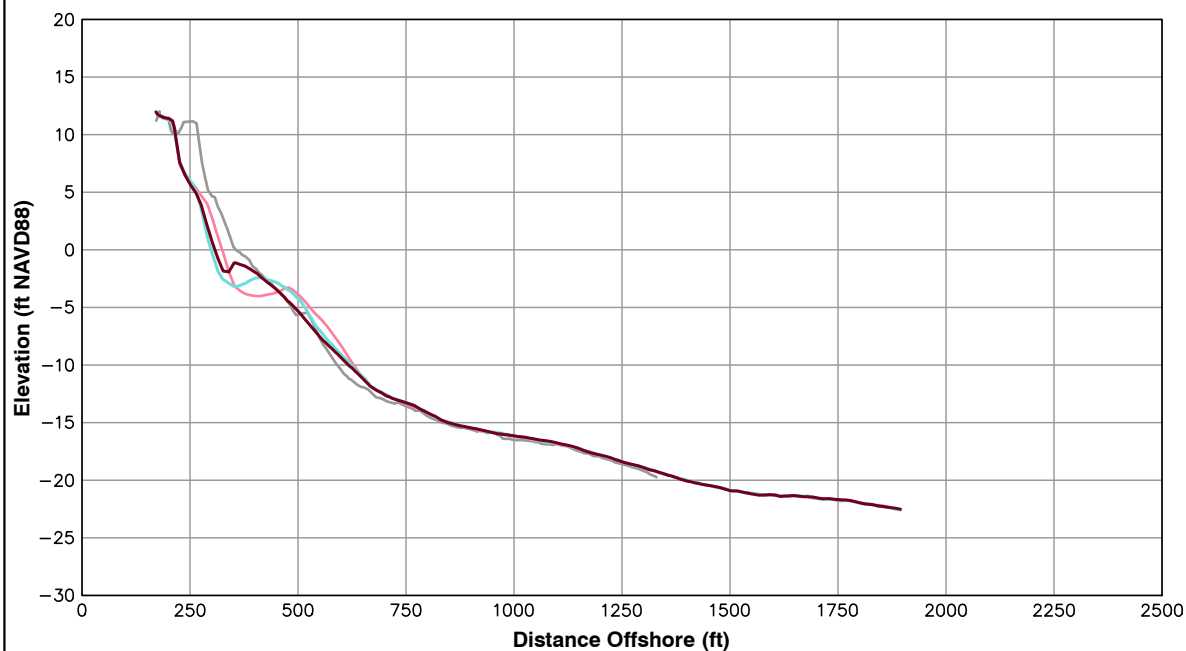


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 141+98**

**Pg 46 of 106**

**Fall 2013**



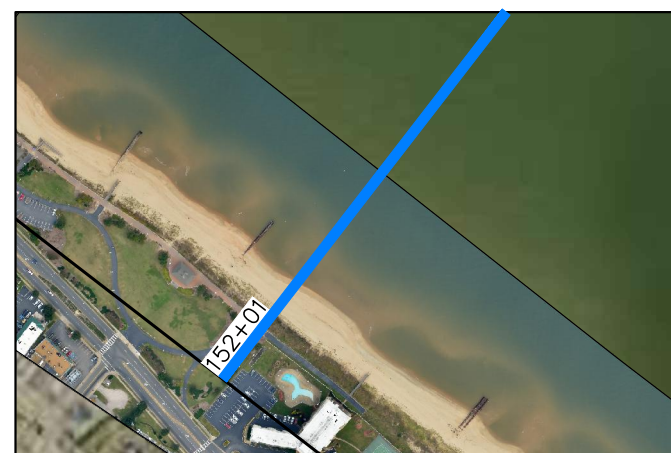
Survey Transect 152+01	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-16.16 ft/yr	7.89 ft
Volume Change Above -15 ft NAVD88	-5.06 cy/ft/yr	0.46 cy/ft
Volume Change Above 0 ft NAVD88	-2.95 cy/ft/yr	0.74 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

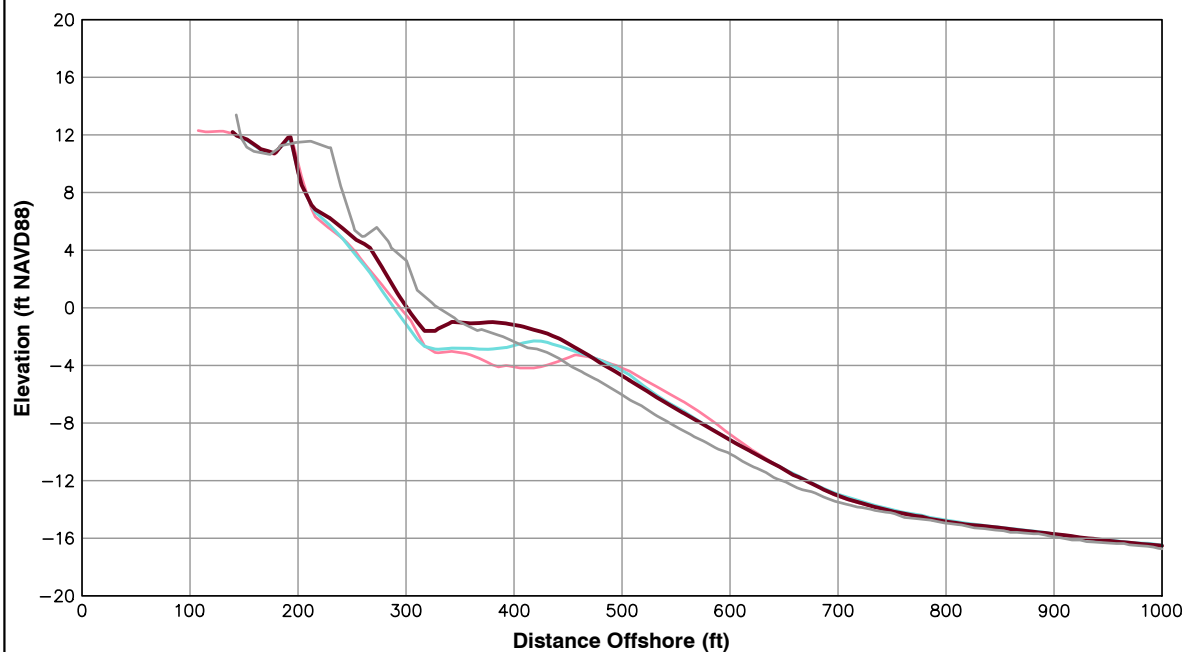
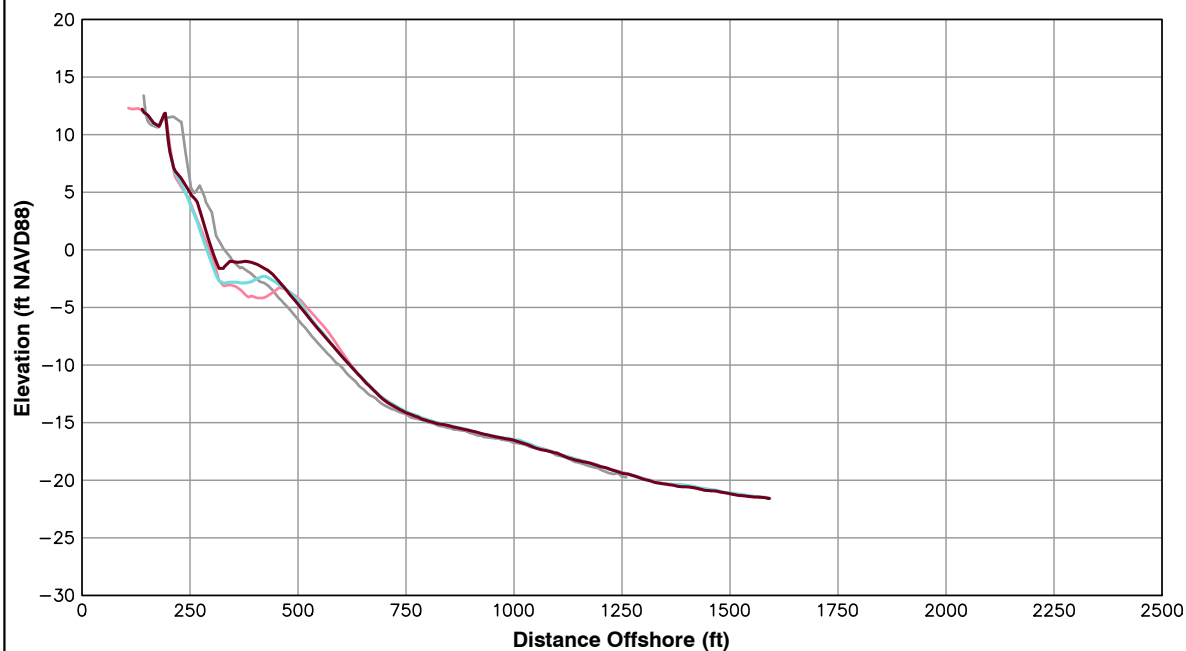


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 152+01**

**Pg 47 of 106**

**Fall 2013**

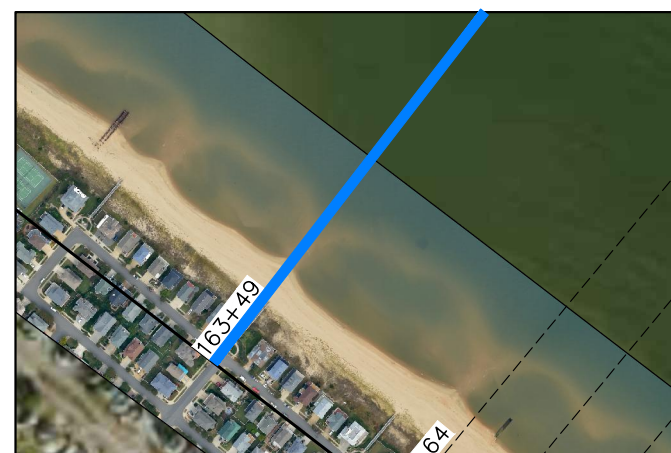


Survey Transect 163+49	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	7.72 ft/yr	12.63 ft
Volume Change Above -15 ft NAVD88	11.09 cy/ft/yr	9.62 cy/ft
Volume Change Above 0 ft NAVD88	2.64 cy/ft/yr	3.32 cy/ft

LEGEND:	
2013 OCT	<span style="color: darkred;">—</span>
2013 APR	<span style="color: cyan;">—</span>
2012 SEP	<span style="color: pink;">—</span>
POST-FILL	<span style="color: grey;">—</span>

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



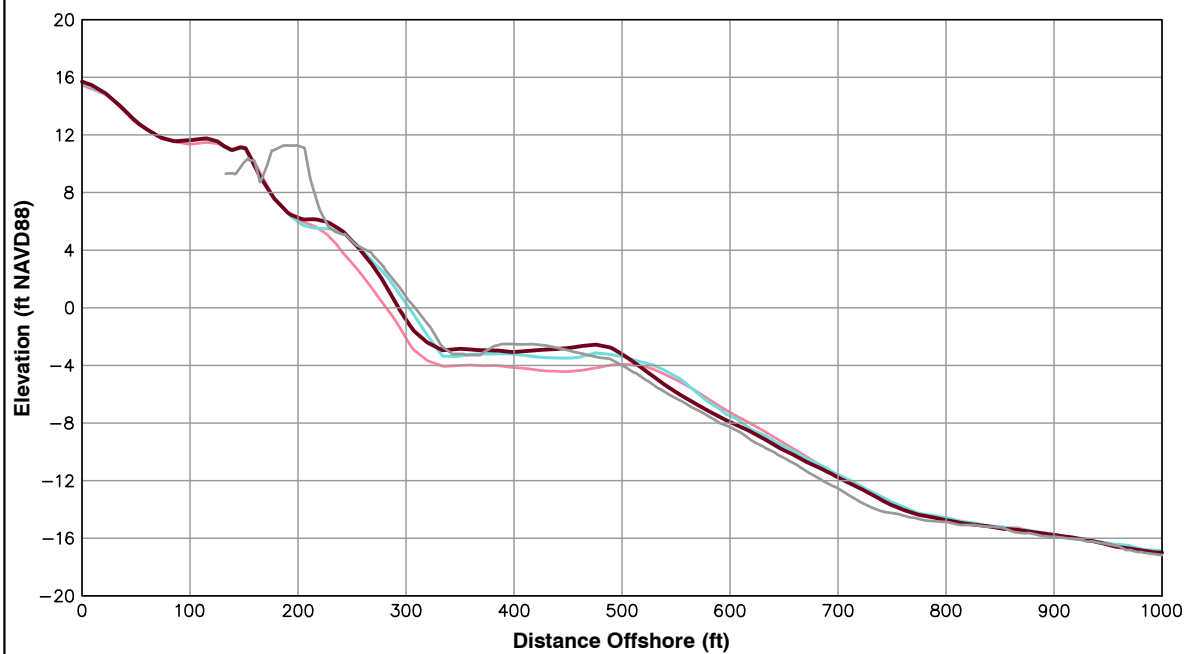
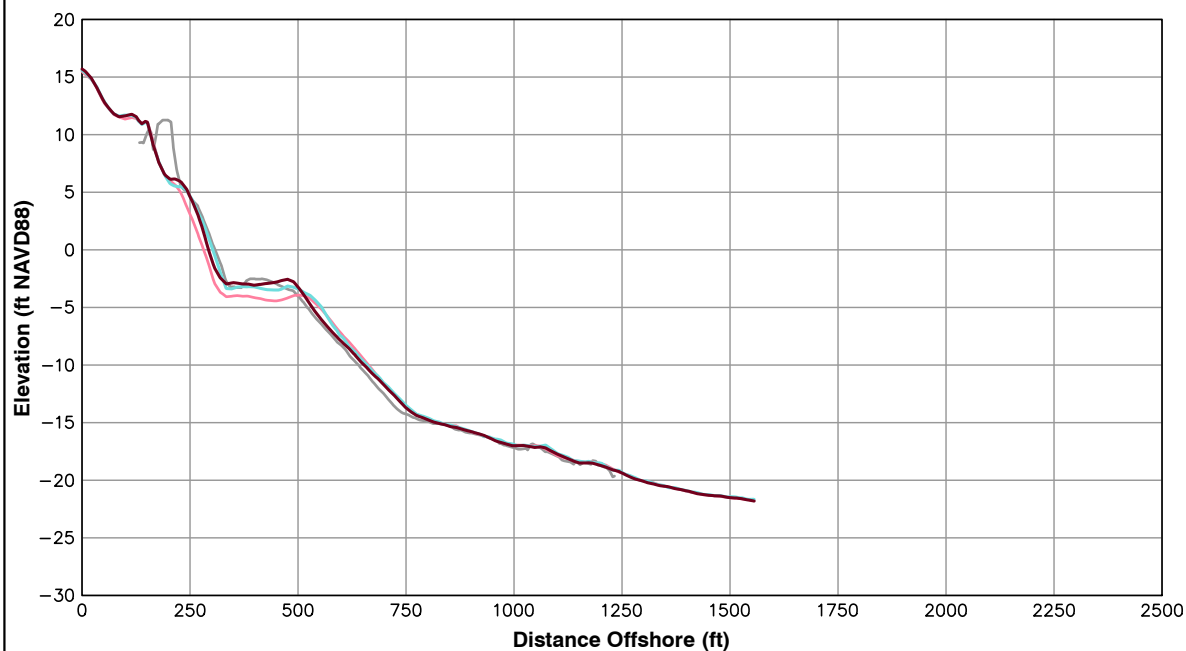
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 163+49

Pg 48 of 106

Fall 2013





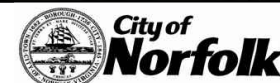
Survey Transect 169+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	12.85 ft/yr	-8.12 ft
Volume Change Above -15 ft NAVD88	9.77 cy/ft/yr	-2.37 cy/ft
Volume Change Above 0 ft NAVD88	4.02 cy/ft/yr	-0.10 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

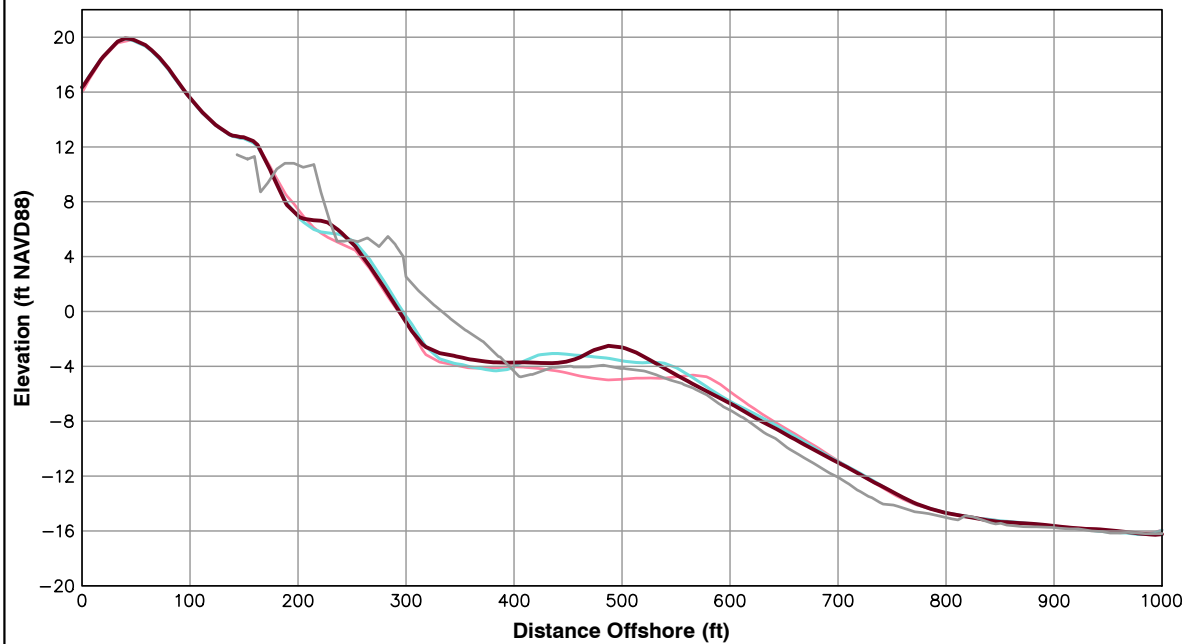
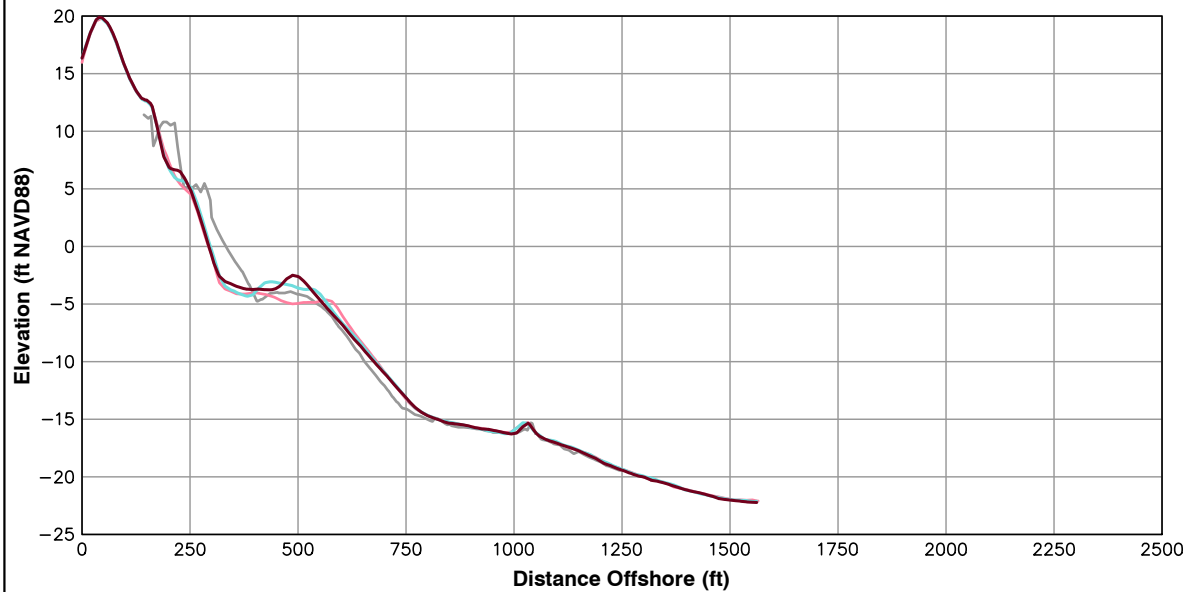


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 169+63

Pg 49 of 106

Fall 2013



Survey Transect 171+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	1.67 ft/yr	-3.32 ft
Volume Change Above -15 ft NAVD88	6.70 cy/ft/yr	0.31 cy/ft
Volume Change Above 0 ft NAVD88	1.27 cy/ft/yr	0.32 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



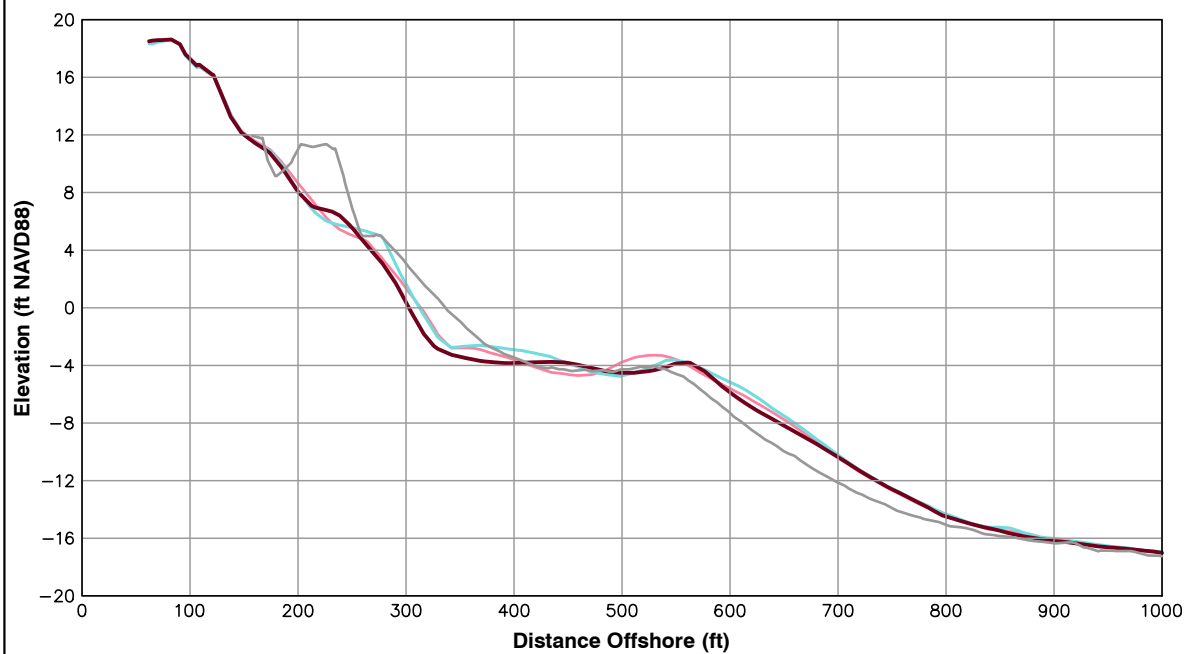
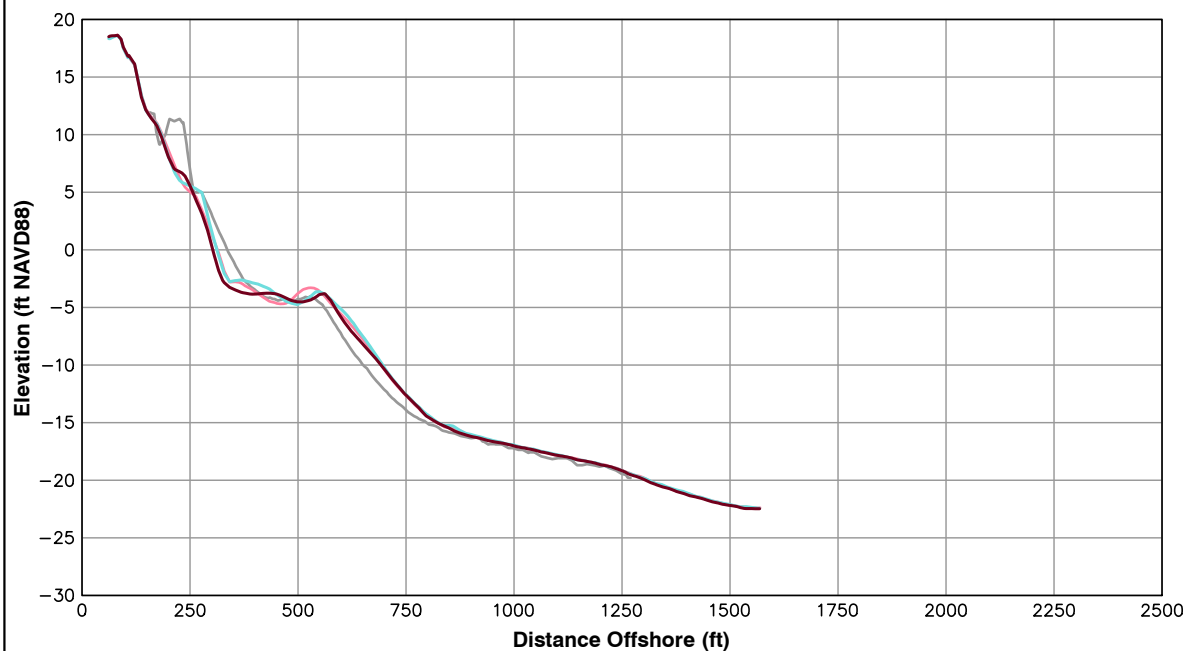
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 171+63

Pg 50 of 106

Fall 2013



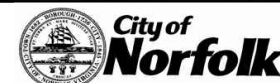
Survey Transect 173+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-7.54 ft/yr	-9.16 ft
Volume Change Above -15 ft NAVD88	-4.73 cy/ft/yr	-9.04 cy/ft
Volume Change Above 0 ft NAVD88	-0.89 cy/ft/yr	-1.81 cy/ft

**LEGEND:**



**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



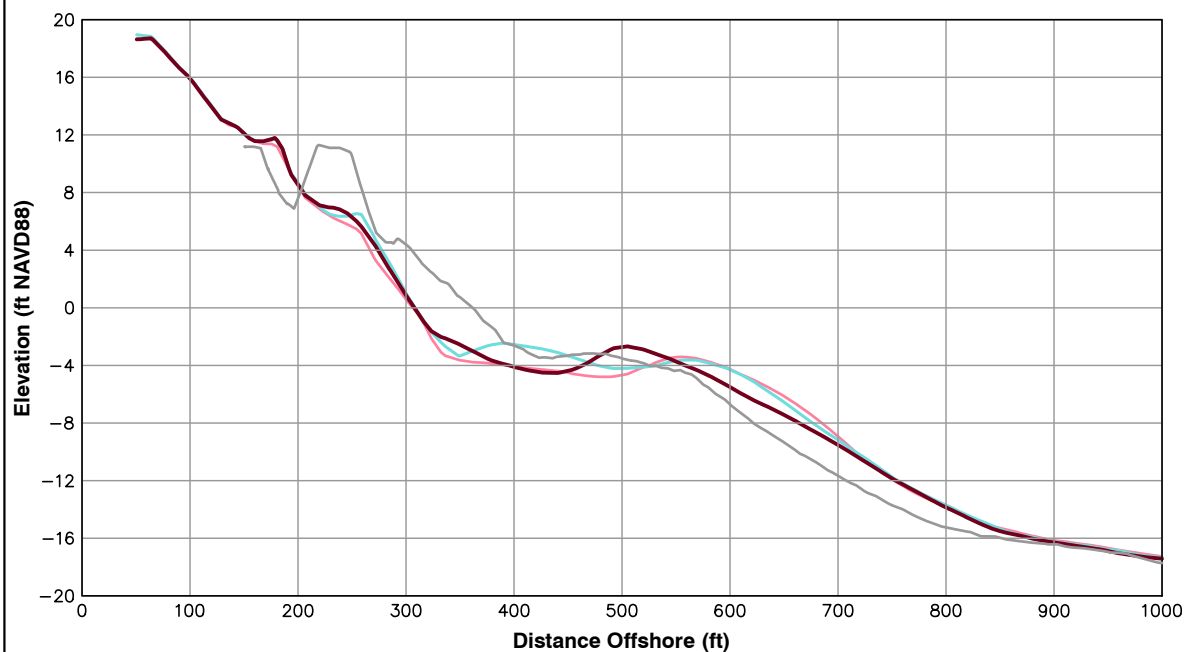
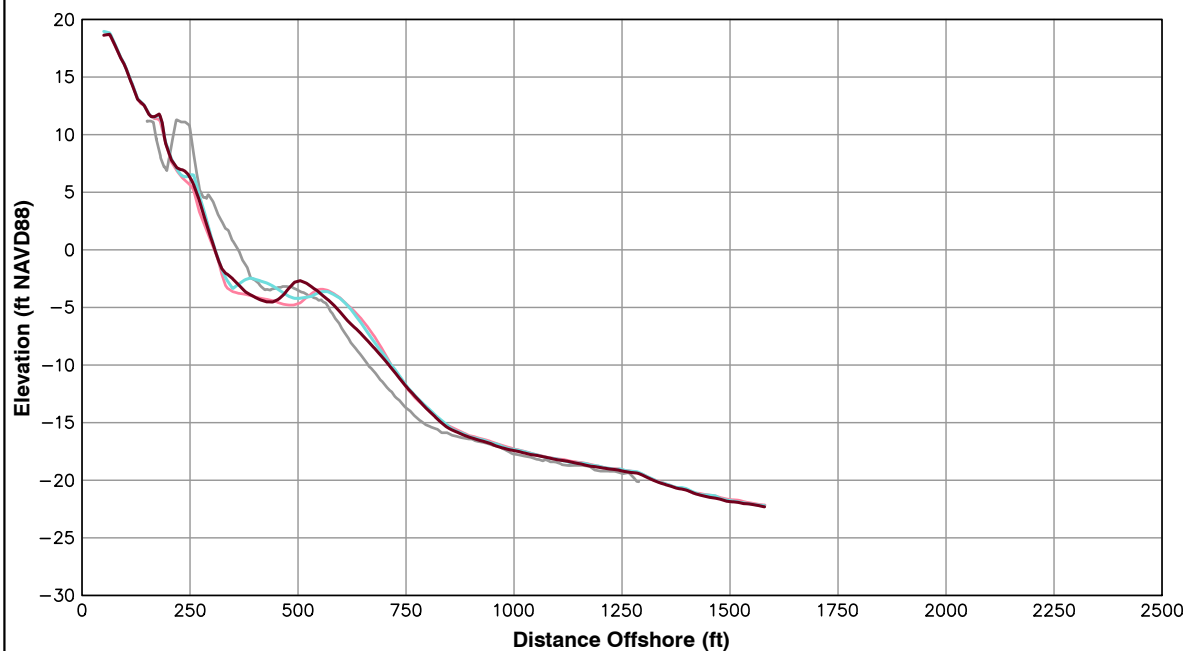
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 173+63

Pg 51 of 106

Fall 2013





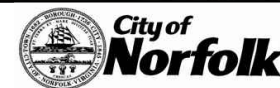
Survey Transect 175+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	2.95 ft/yr	-1.25 ft
Volume Change Above -15 ft NAVD88	1.79 cy/ft/yr	-7.48 cy/ft
Volume Change Above 0 ft NAVD88	2.33 cy/ft/yr	-0.87 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

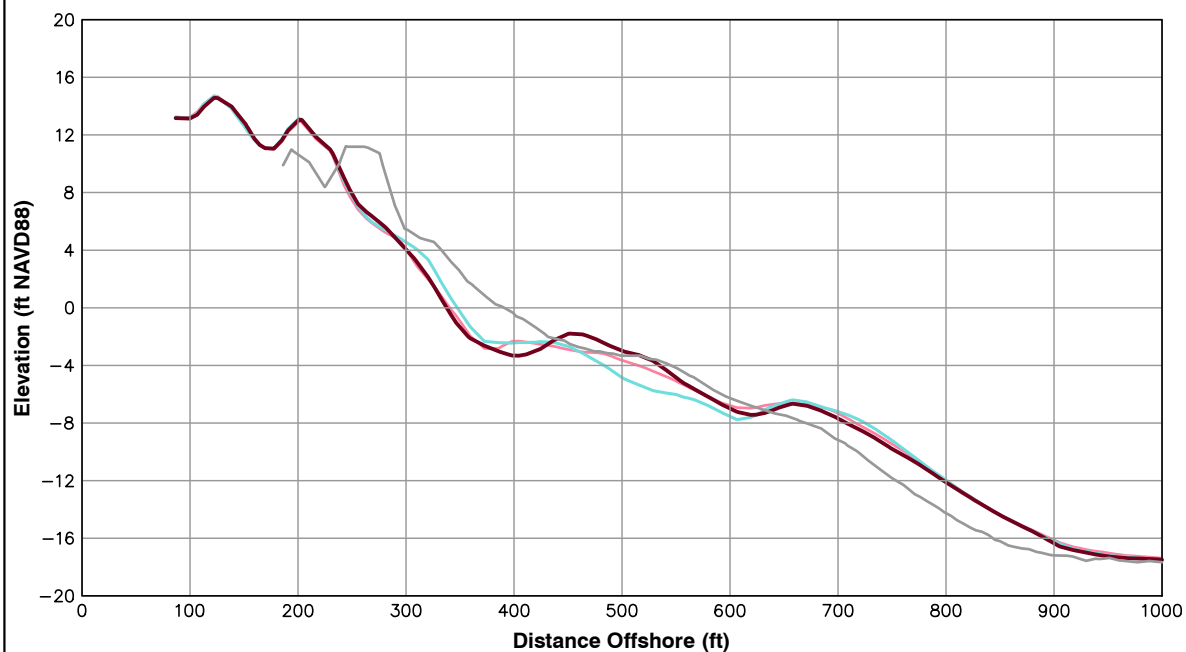
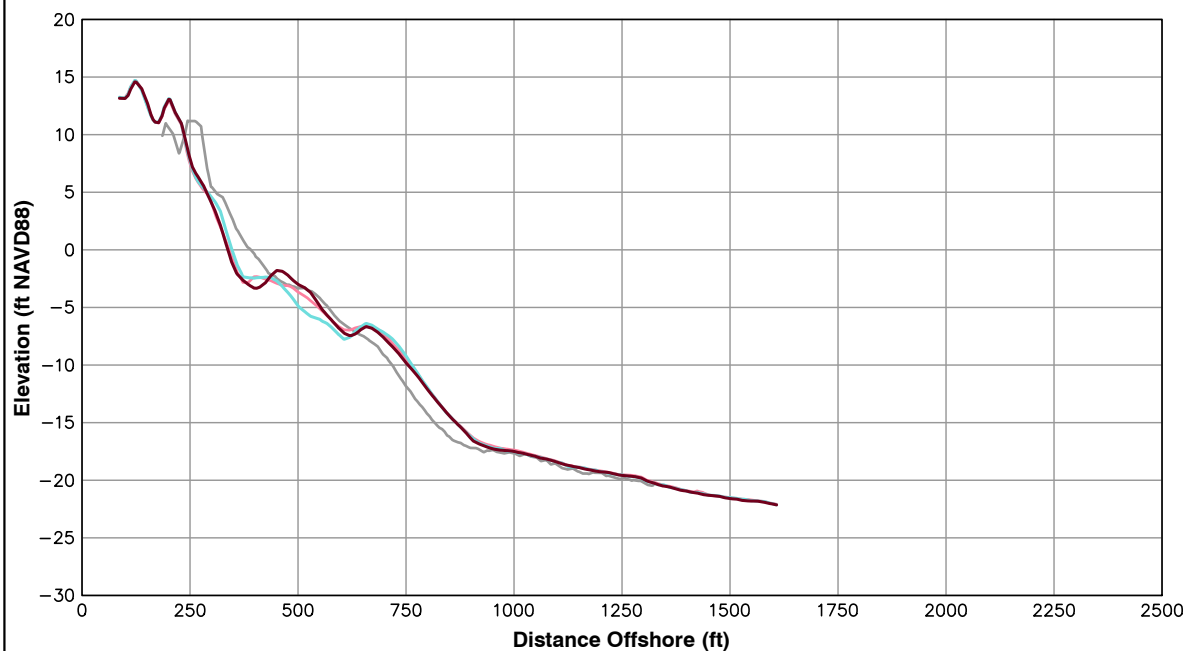


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 175+63

Pg 52 of 106

Fall 2013



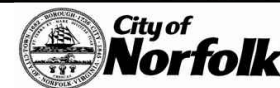
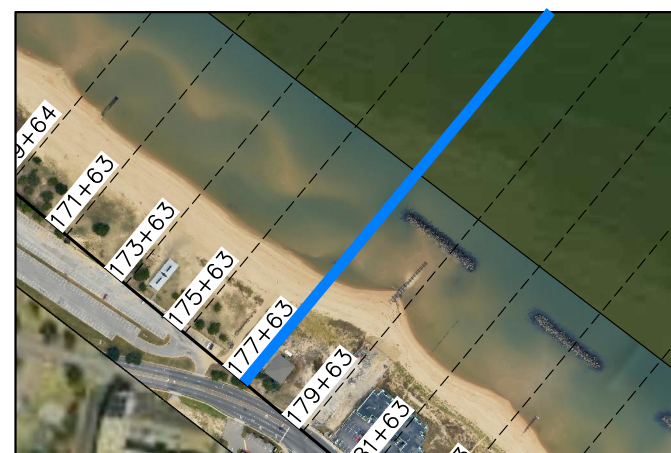
Survey Transect 177+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.13 ft/yr	-9.22 ft
Volume Change Above -15 ft NAVD88	0.76 cy/ft/yr	1.83 cy/ft
Volume Change Above 0 ft NAVD88	0.96 cy/ft/yr	-1.31 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

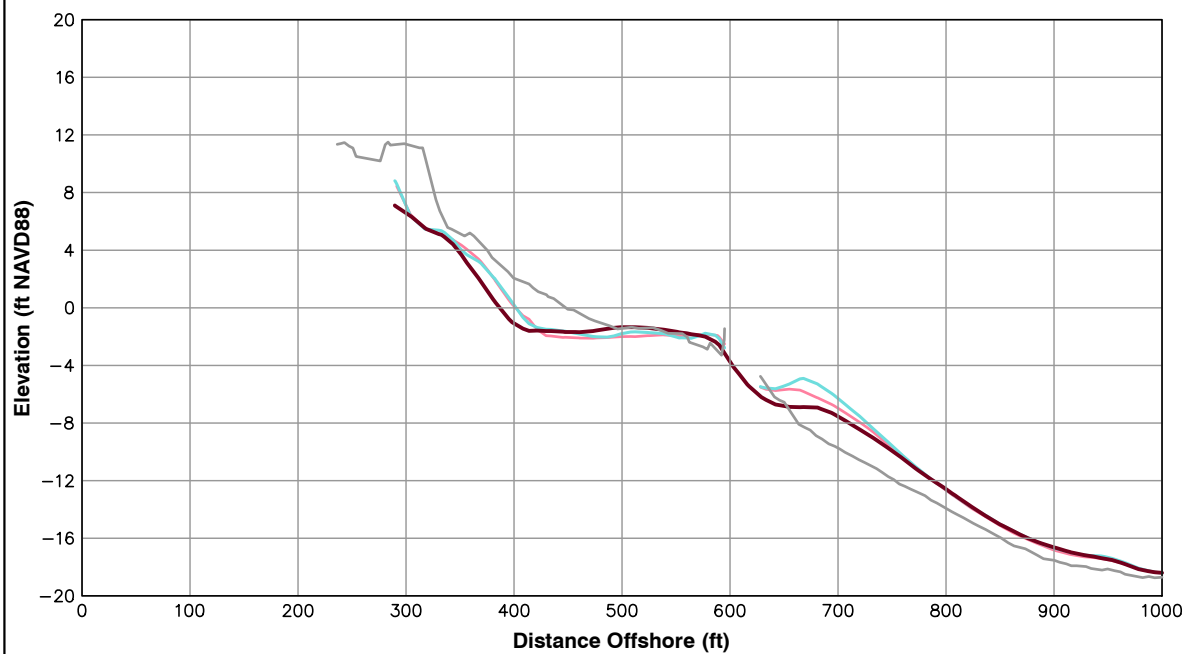
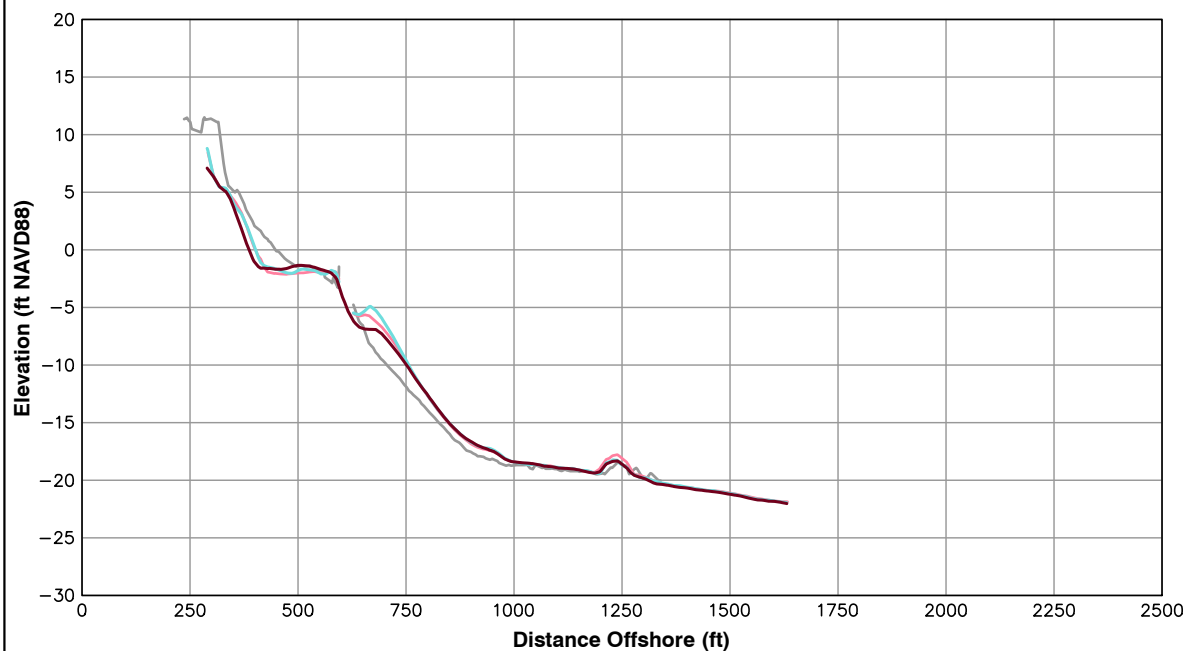


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 177+63

Pg 53 of 106

Fall 2013



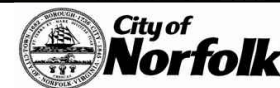
Survey Transect 179+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-13.32 ft/yr	-15.42 ft
Volume Change Above -15 ft NAVD88	-4.37 cy/ft/yr	-7.94 cy/ft
Volume Change Above 0 ft NAVD88	-2.48 cy/ft/yr	-2.68 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



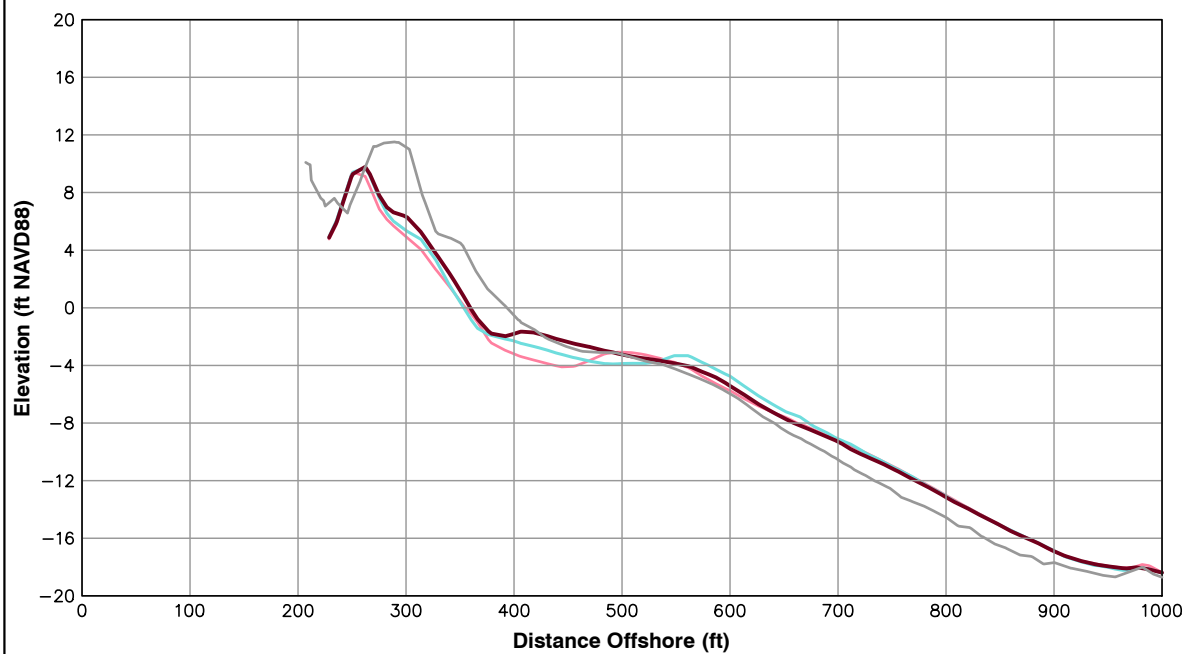
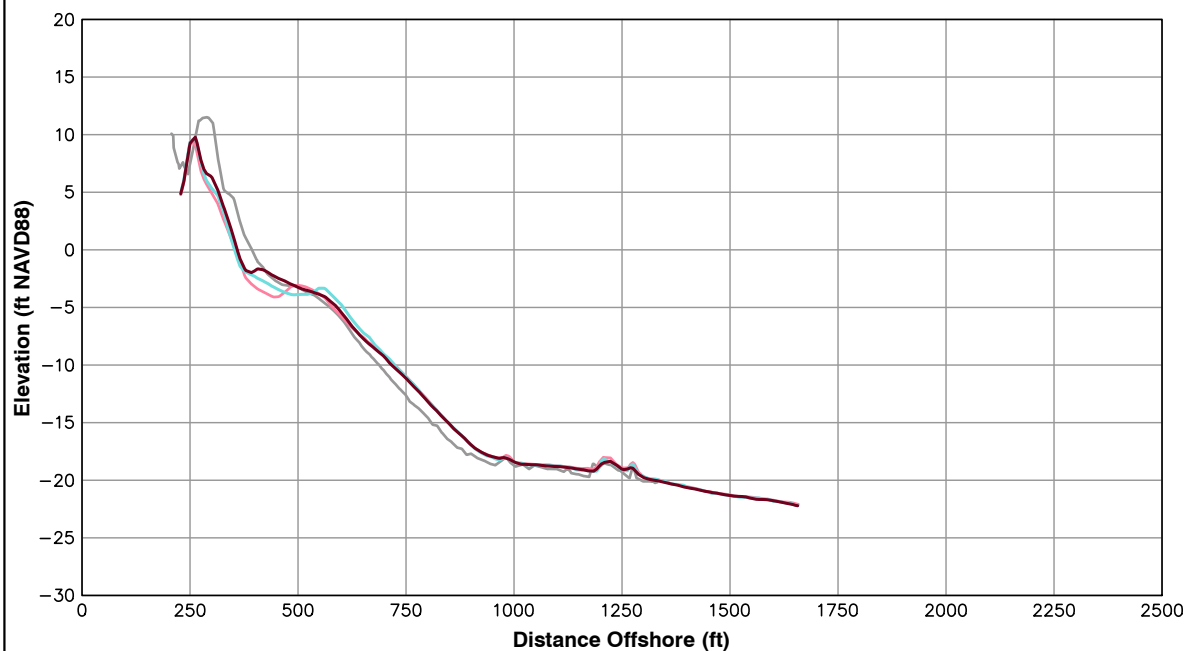
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 179+63**

**Pg 54 of 106**

**Fall 2013**





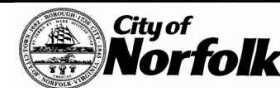
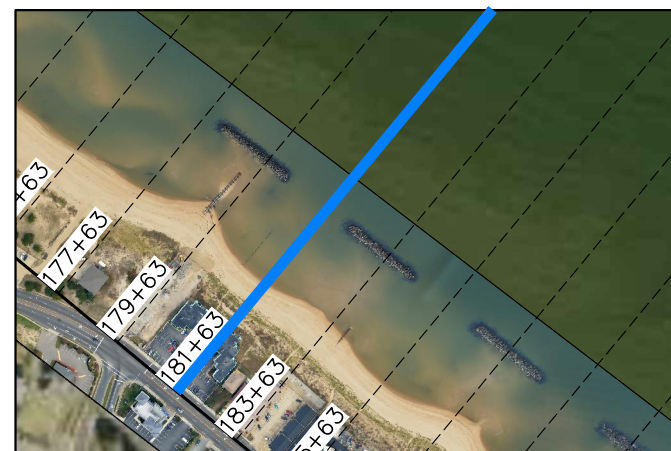
Survey Transect 181+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	6.36 ft/yr	6.65 ft
Volume Change Above -15 ft NAVD88	8.32 cy/ft/yr	2.50 cy/ft
Volume Change Above 0 ft NAVD88	3.48 cy/ft/yr	1.89 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

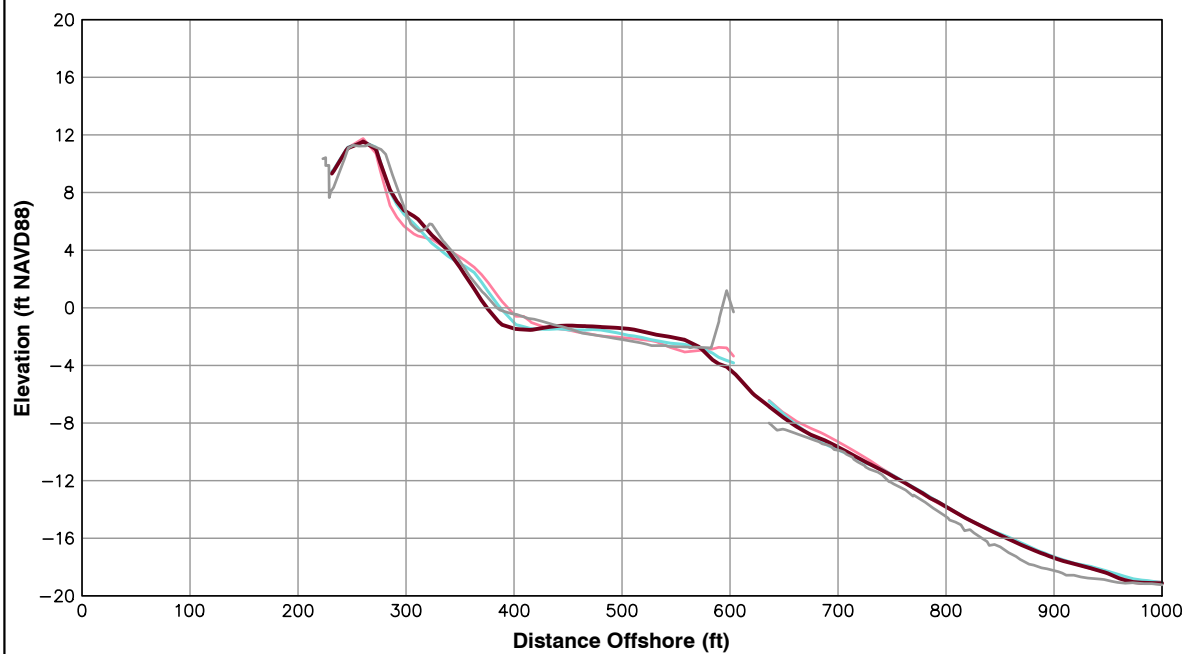
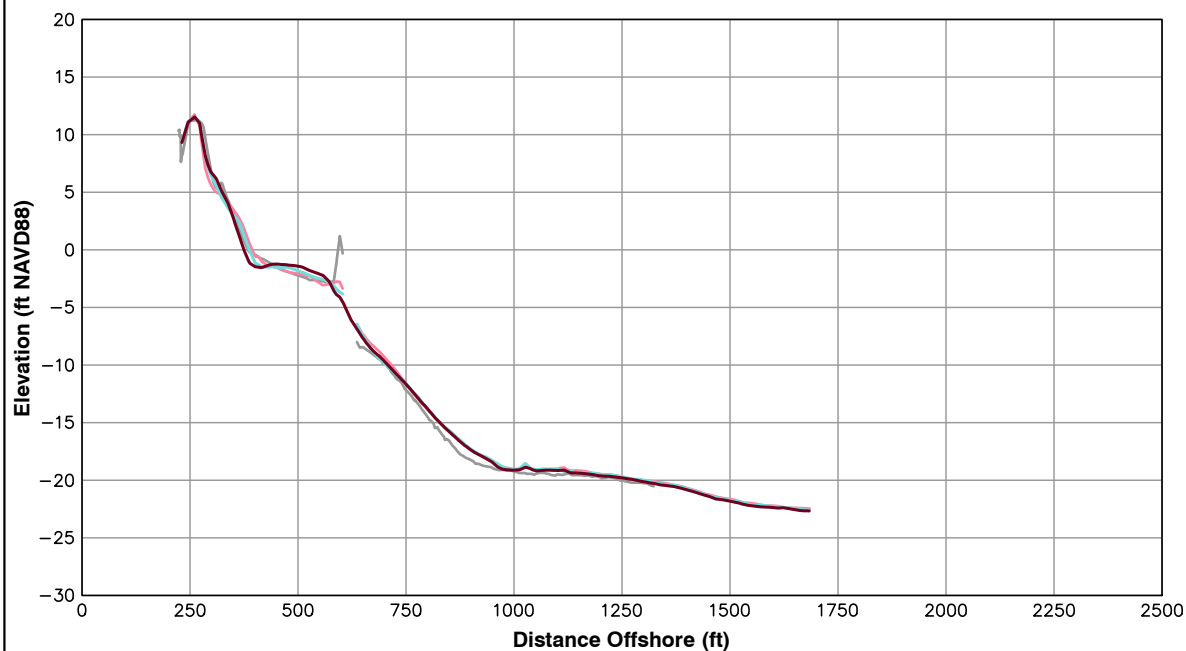


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 181+63**

**Pg 55 of 106**

**Fall 2013**



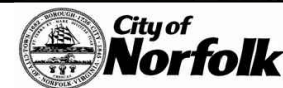
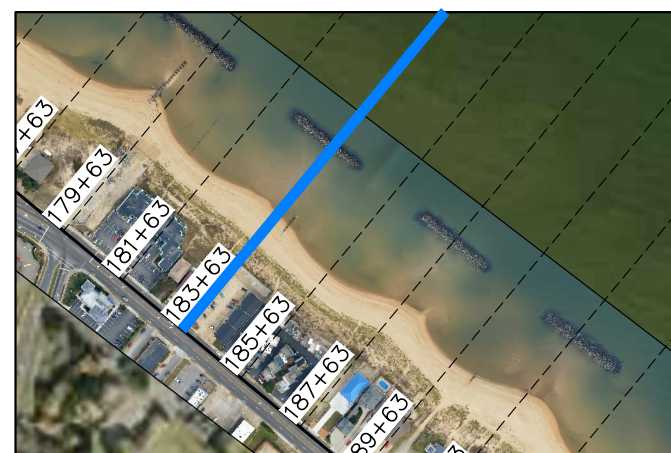
Survey Transect 183+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-16.59 ft/yr	-11.49 ft
Volume Change Above -15 ft NAVD88	-1.17 cy/ft/yr	0.00 cy/ft
Volume Change Above 0 ft NAVD88	-0.31 cy/ft/yr	-0.38 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

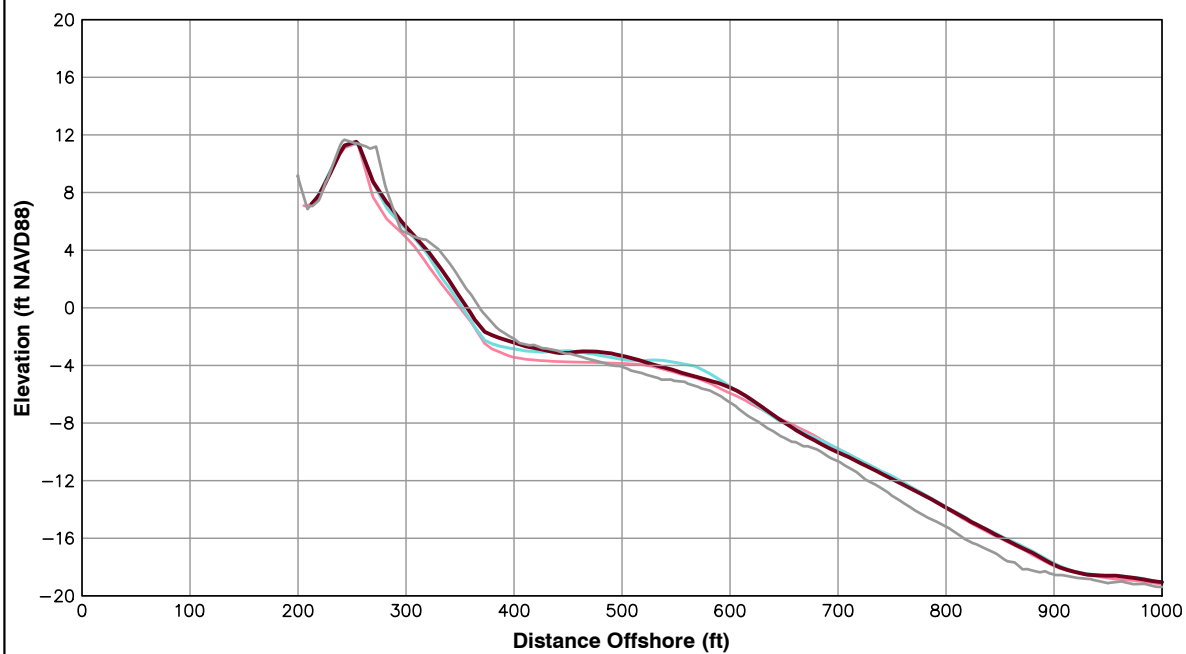
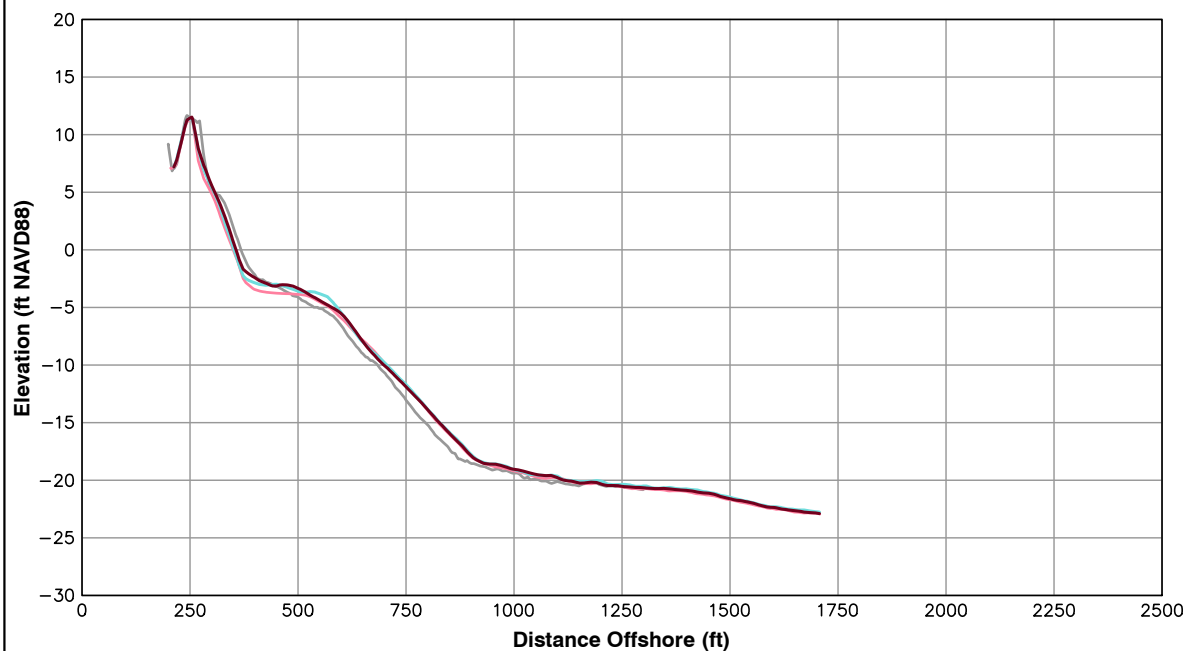


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 183+63**

**Pg 56 of 106**

**Fall 2013**



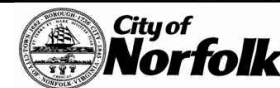
Survey Transect 185+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	7.43 ft/yr	4.23 ft
Volume Change Above -15 ft NAVD88	7.55 cy/ft/yr	0.39 cy/ft
Volume Change Above 0 ft NAVD88	3.19 cy/ft/yr	1.02 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



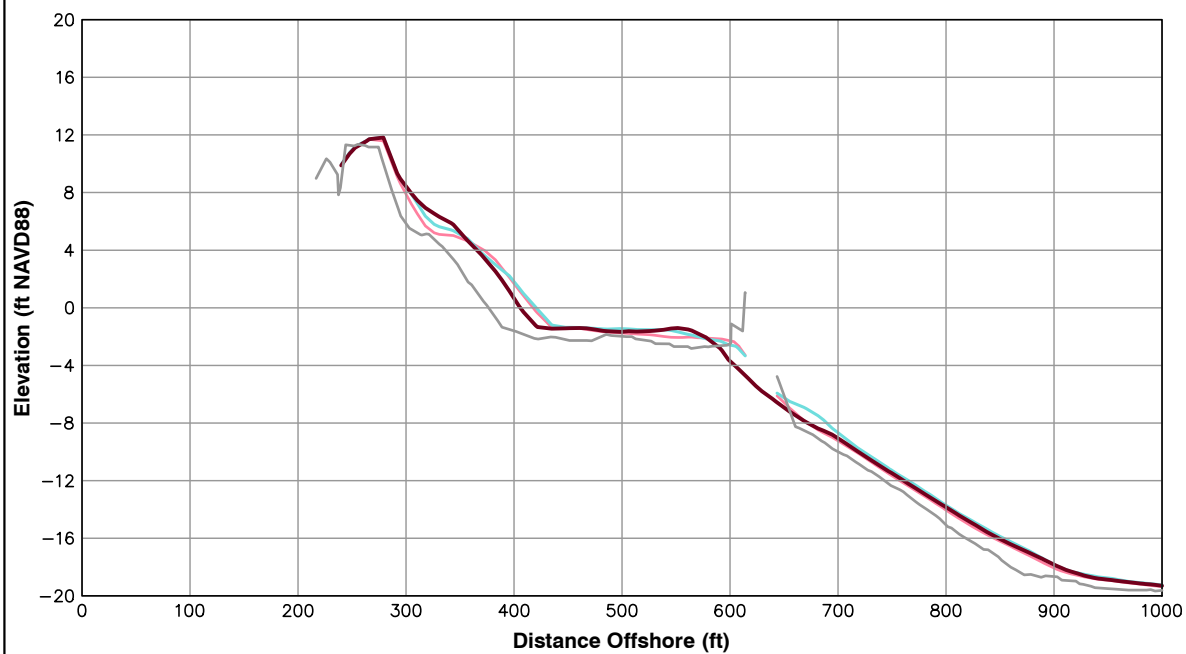
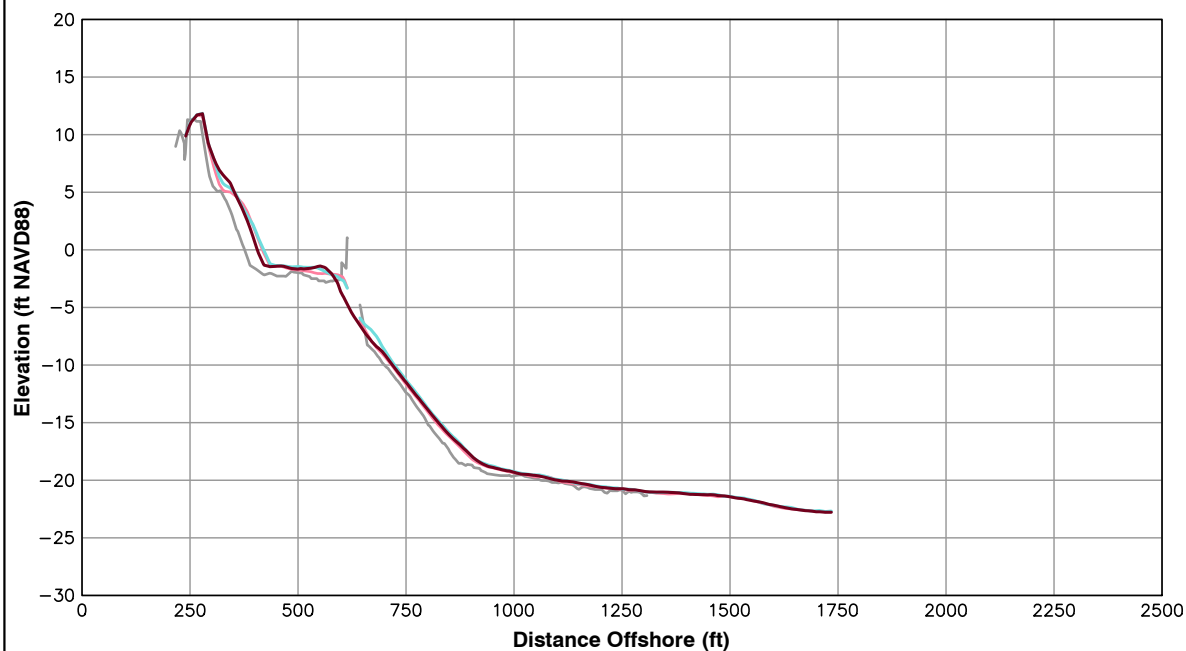
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 185+63**

**Pg 57 of 106**

**Fall 2013**





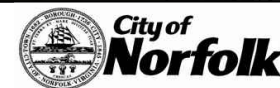
Survey Transect 187+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-9.40 ft/yr	-11.64 ft
Volume Change Above -15 ft NAVD88	0.50 cy/ft/yr	-5.10 cy/ft
Volume Change Above 0 ft NAVD88	0.67 cy/ft/yr	-0.60 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

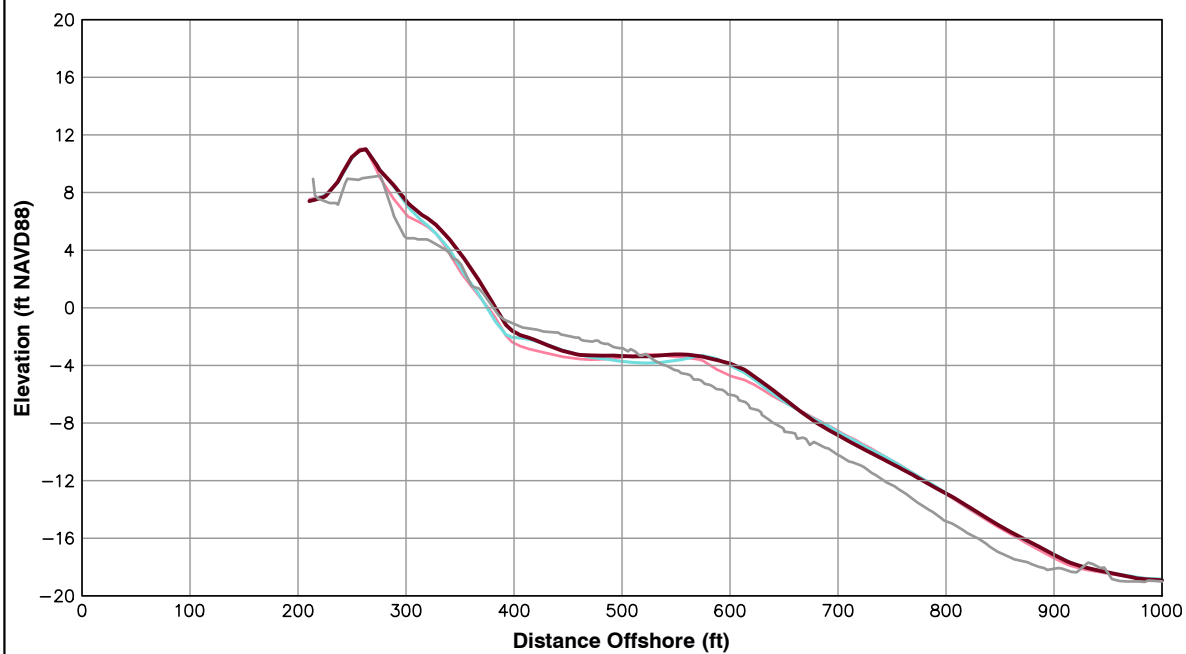
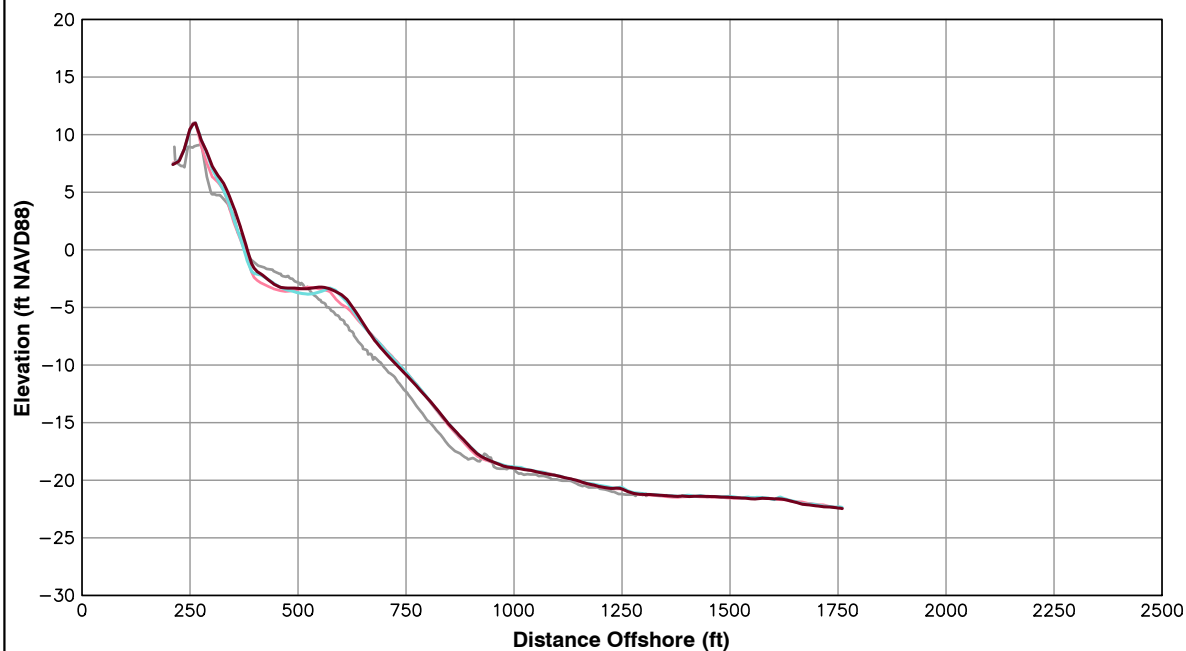


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 187+63**

**Pg 58 of 106**

**Fall 2013**



Survey Transect 189+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	8.60 ft/yr	7.95 ft
Volume Change Above -15 ft NAVD88	6.20 cy/ft/yr	3.70 cy/ft
Volume Change Above 0 ft NAVD88	3.20 cy/ft/yr	2.17 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

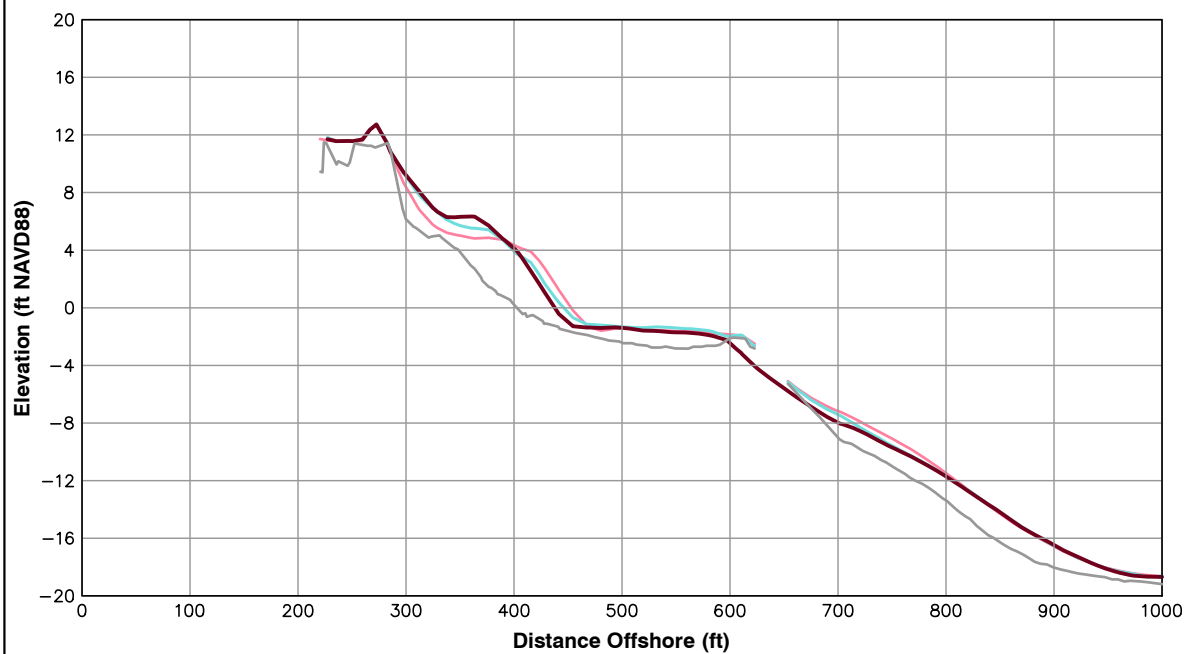
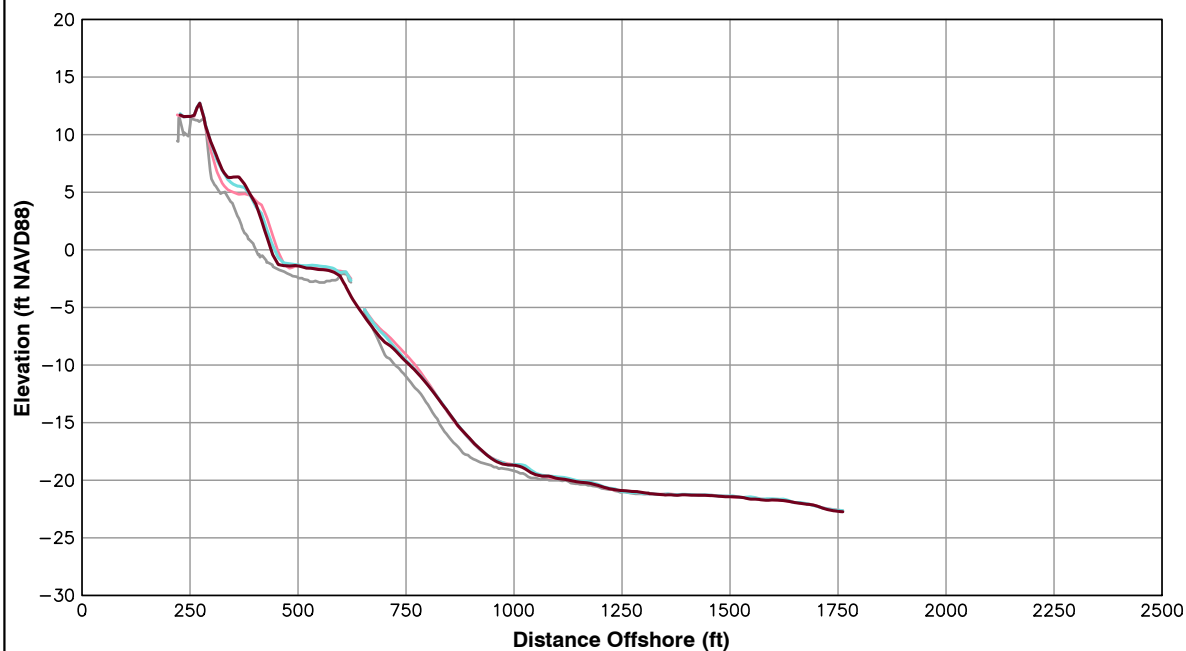


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 189+63

Pg 59 of 106

Fall 2013



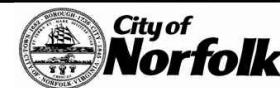
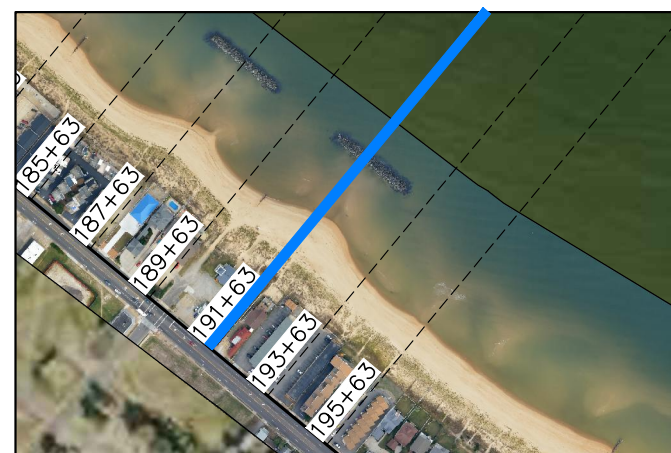
Survey Transect 191+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-13.85 ft/yr	-6.08 ft
Volume Change Above -15 ft NAVD88	-3.50 cy/ft/yr	-3.81 cy/ft
Volume Change Above 0 ft NAVD88	1.61 cy/ft/yr	0.42 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



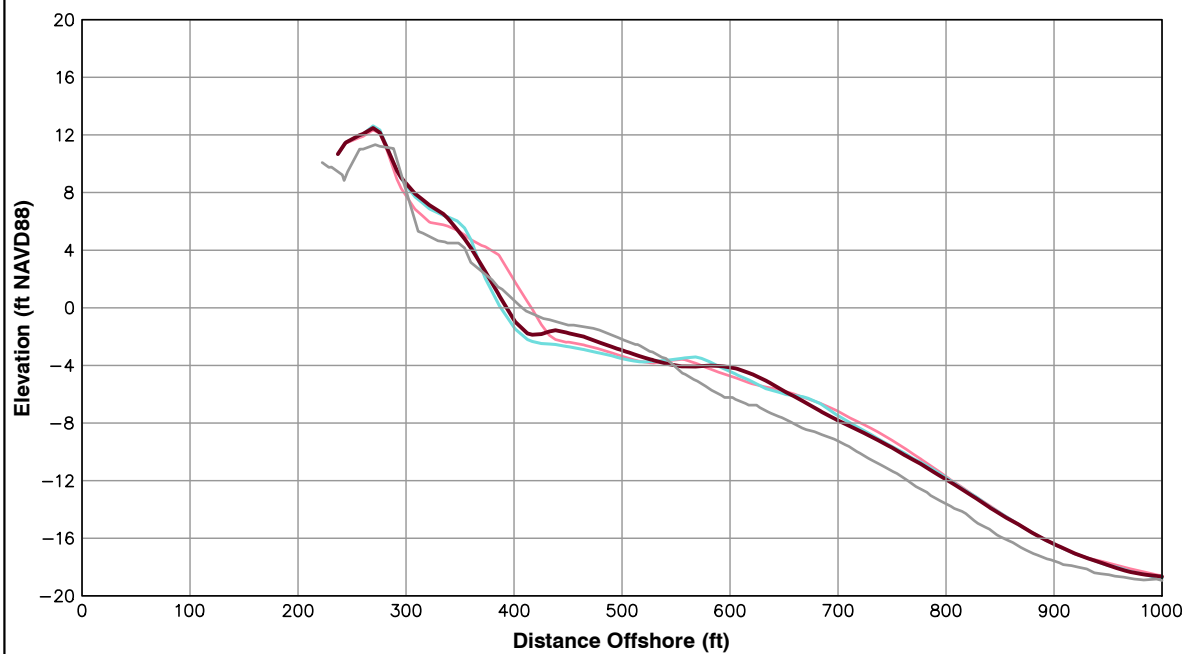
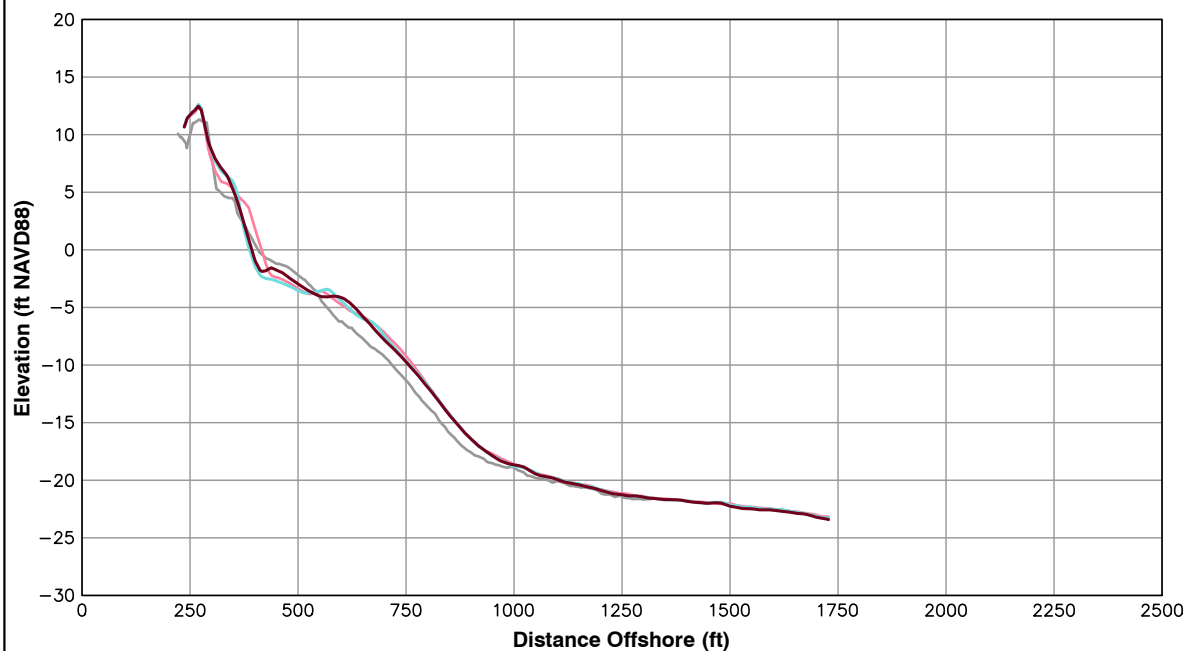
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 191+63**

**Pg 60 of 106**

**Fall 2013**





Survey Transect 193+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-21.19 ft/yr	4.70 ft
Volume Change Above -15 ft NAVD88	-3.06 cy/ft/yr	2.25 cy/ft
Volume Change Above 0 ft NAVD88	-1.48 cy/ft/yr	0.13 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



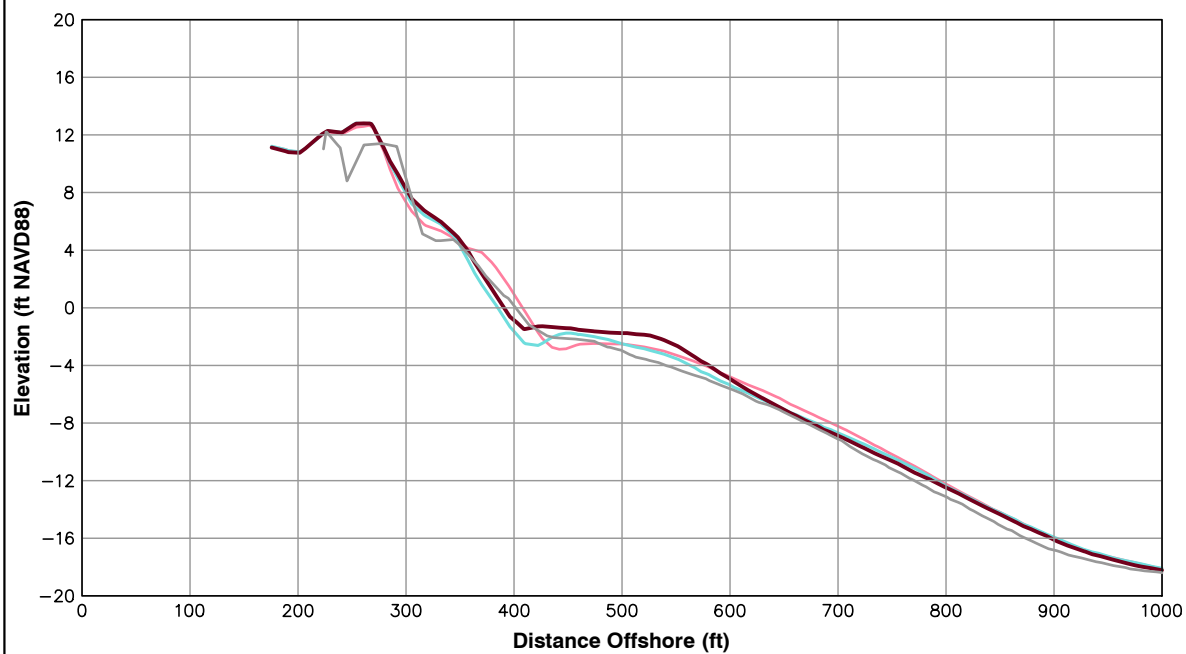
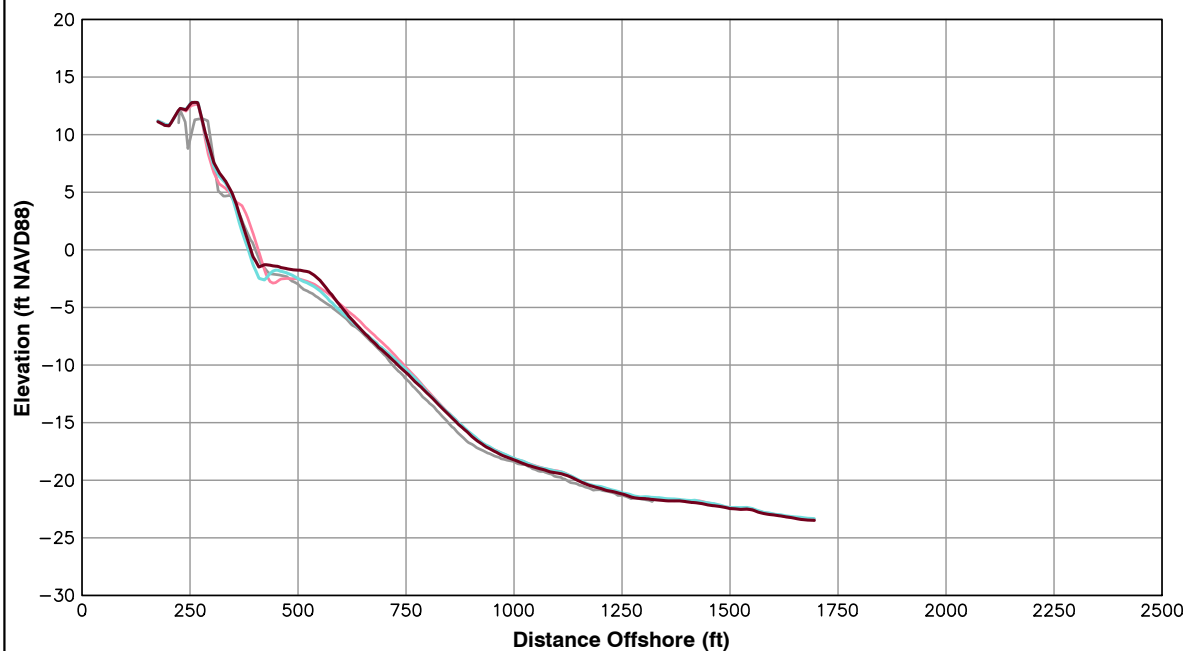
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 193+63**

**Pg 61 of 106**

**Fall 2013**



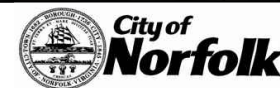
Survey Transect 195+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-16.52 ft/yr	6.31 ft
Volume Change Above -15 ft NAVD88	-0.48 cy/ft/yr	6.14 cy/ft
Volume Change Above 0 ft NAVD88	-0.31 cy/ft/yr	1.49 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

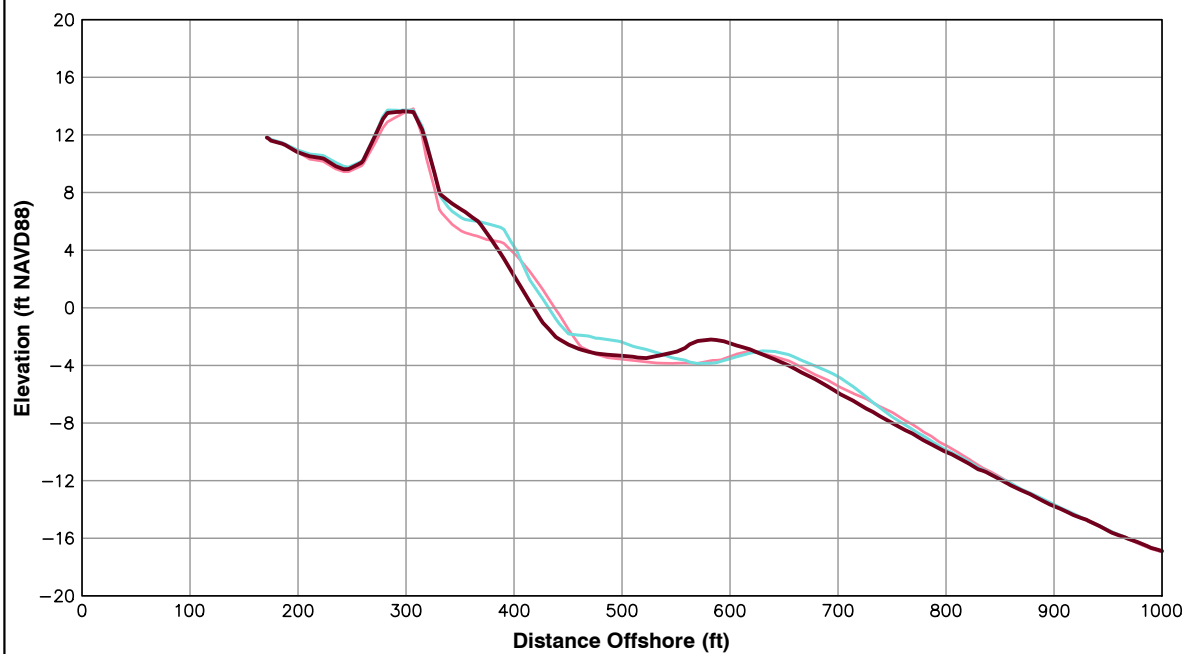
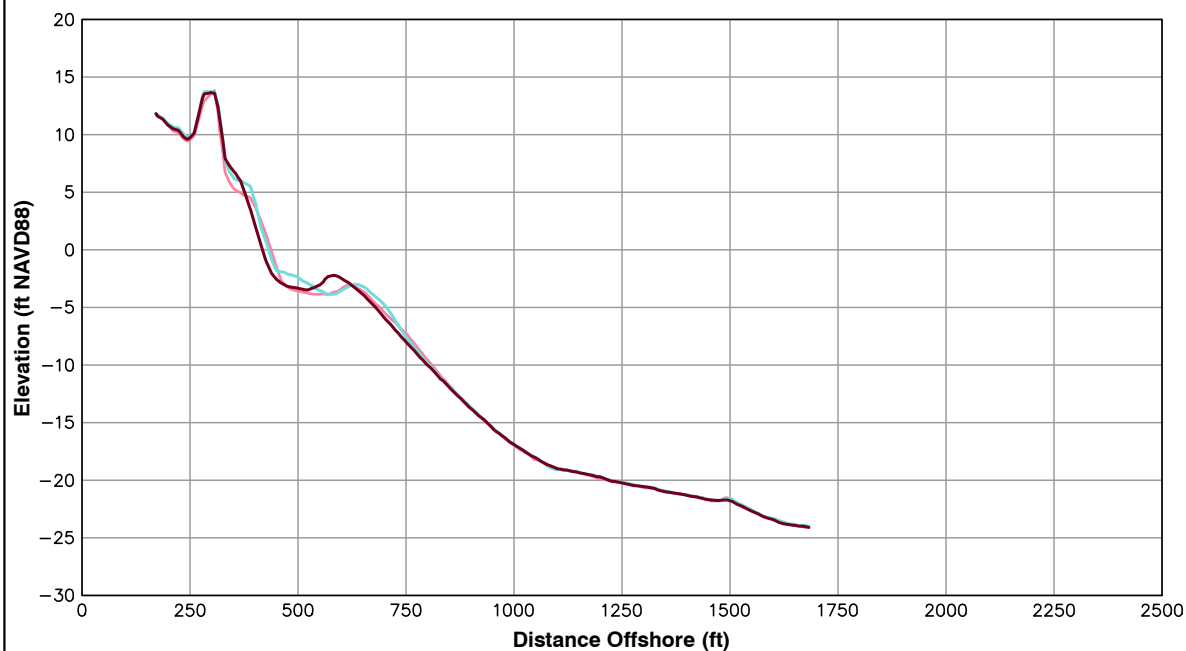


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 195+63**

**Pg 62 of 106**

**Fall 2013**



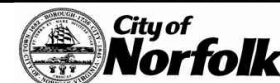
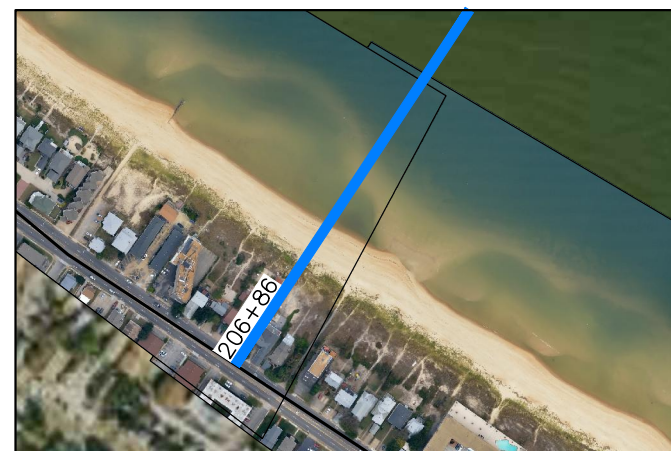
Survey Transect 206+86	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-17.99 ft/yr	-13.23 ft
Volume Change Above -15 ft NAVD88	-0.99 cy/ft/yr	-8.88 cy/ft
Volume Change Above 0 ft NAVD88	0.79 cy/ft/yr	-3.46 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



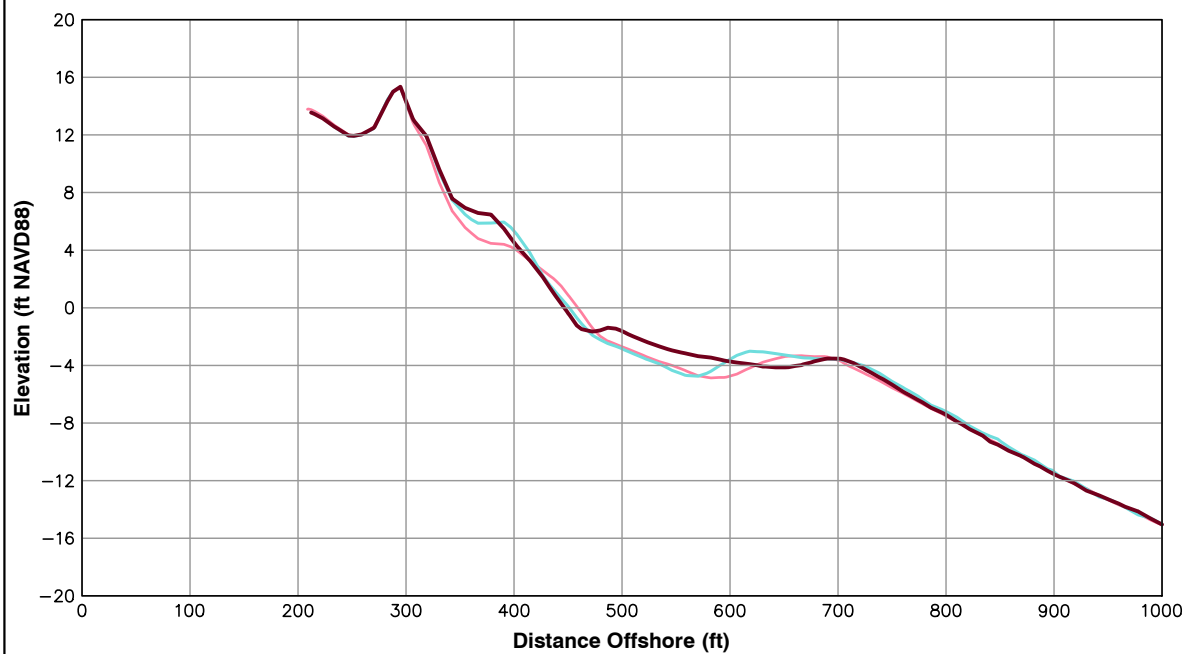
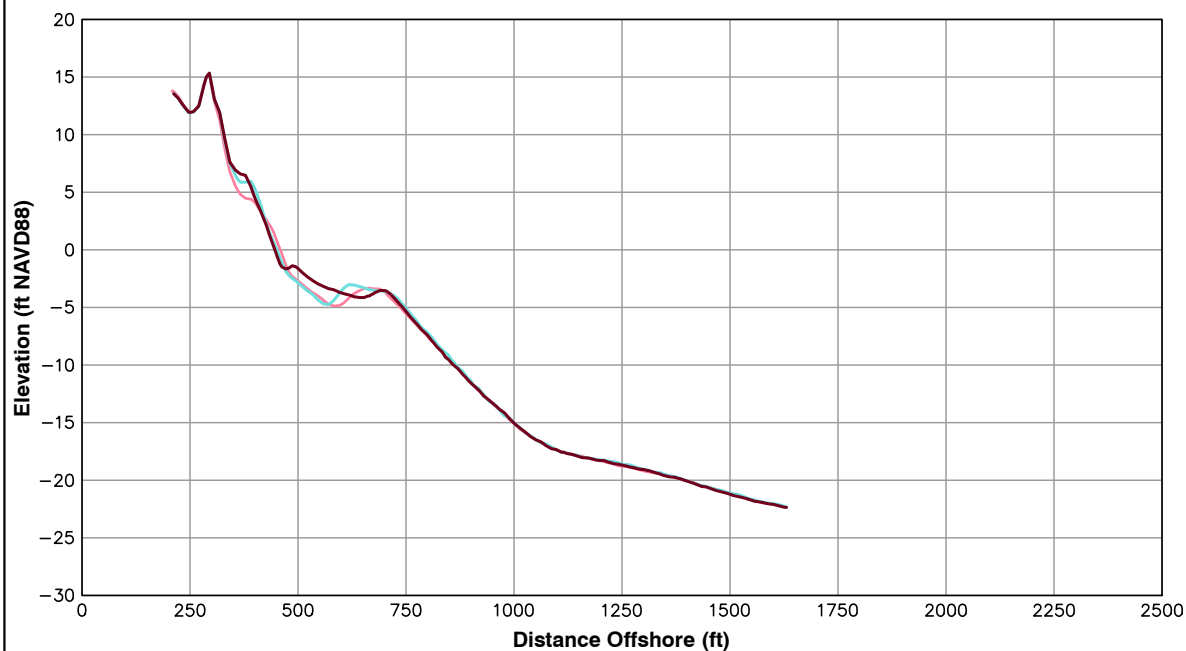
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 206+86**

**Pg 63 of 106**

**Fall 2013**





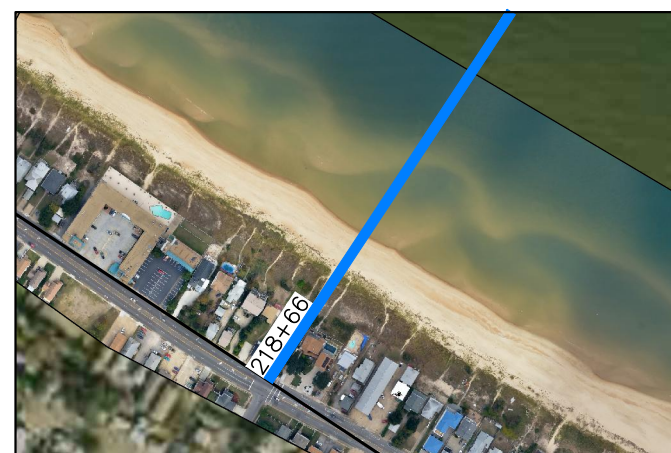
Survey Transect 218+66	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-11.41 ft/yr	-2.82 ft
Volume Change Above -15 ft NAVD88	6.69 cy/ft/yr	1.07 cy/ft
Volume Change Above 0 ft NAVD88	2.65 cy/ft/yr	-0.09 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



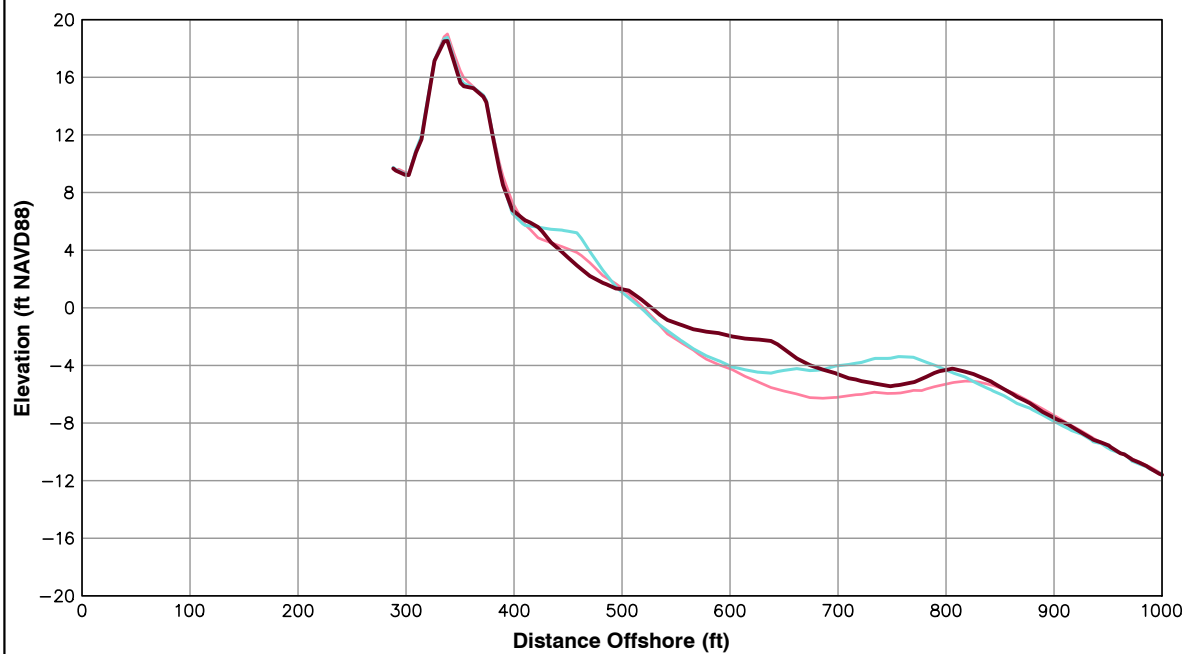
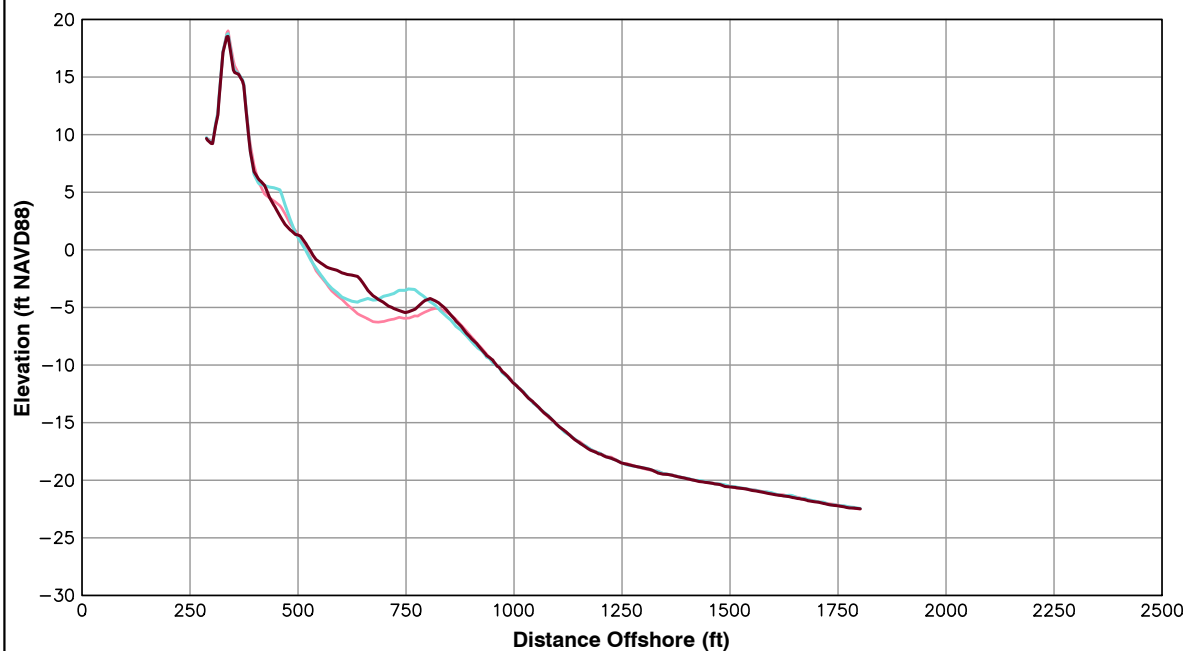
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 218+66**

**Pg 64 of 106**

**Fall 2013**



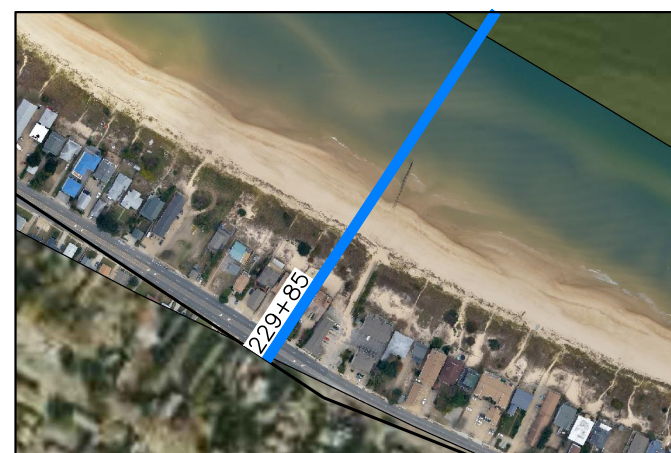
Survey Transect 229+85	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	3.99 ft/yr	8.53 ft
Volume Change Above -15 ft NAVD88	14.51 cy/ft/yr	2.09 cy/ft
Volume Change Above 0 ft NAVD88	-1.64 cy/ft/yr	-3.18 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



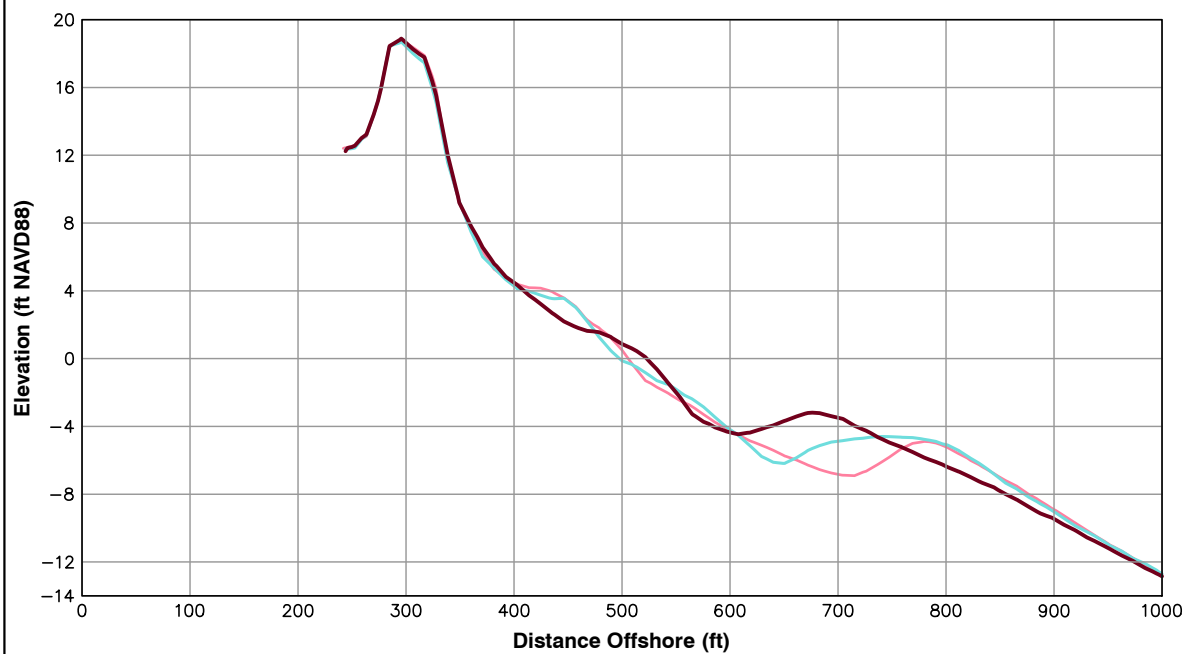
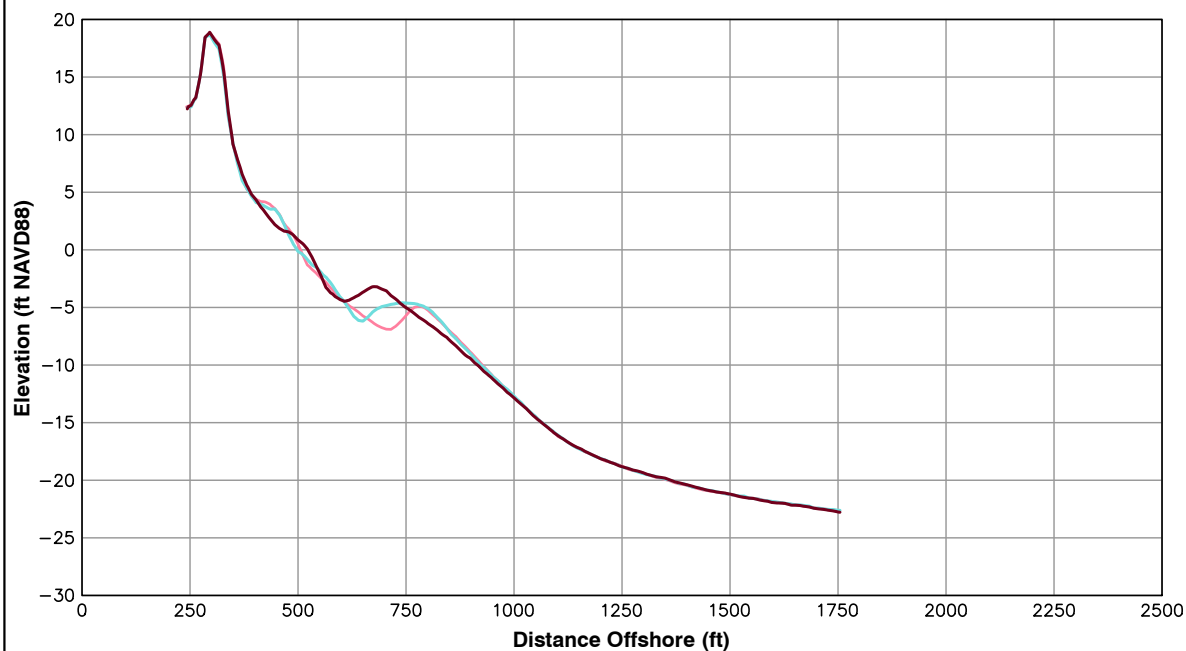
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 229+85

Pg 65 of 106

Fall 2013



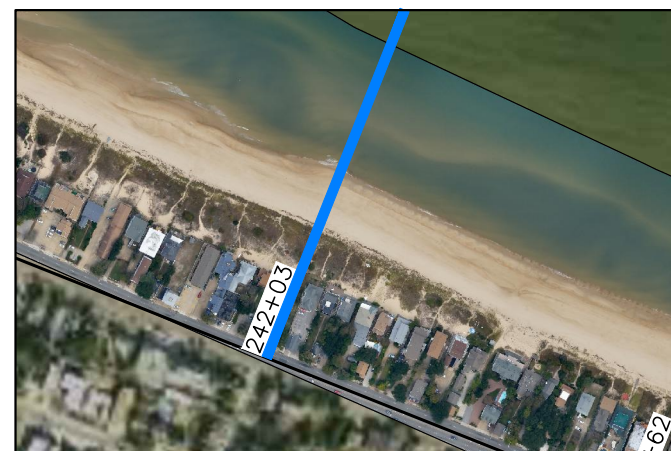
Survey Transect 242+03	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	3.64 ft/yr	14.41 ft
Volume Change Above -15 ft NAVD88	4.51 cy/ft/yr	1.13 cy/ft
Volume Change Above 0 ft NAVD88	-1.72 cy/ft/yr	0.47 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



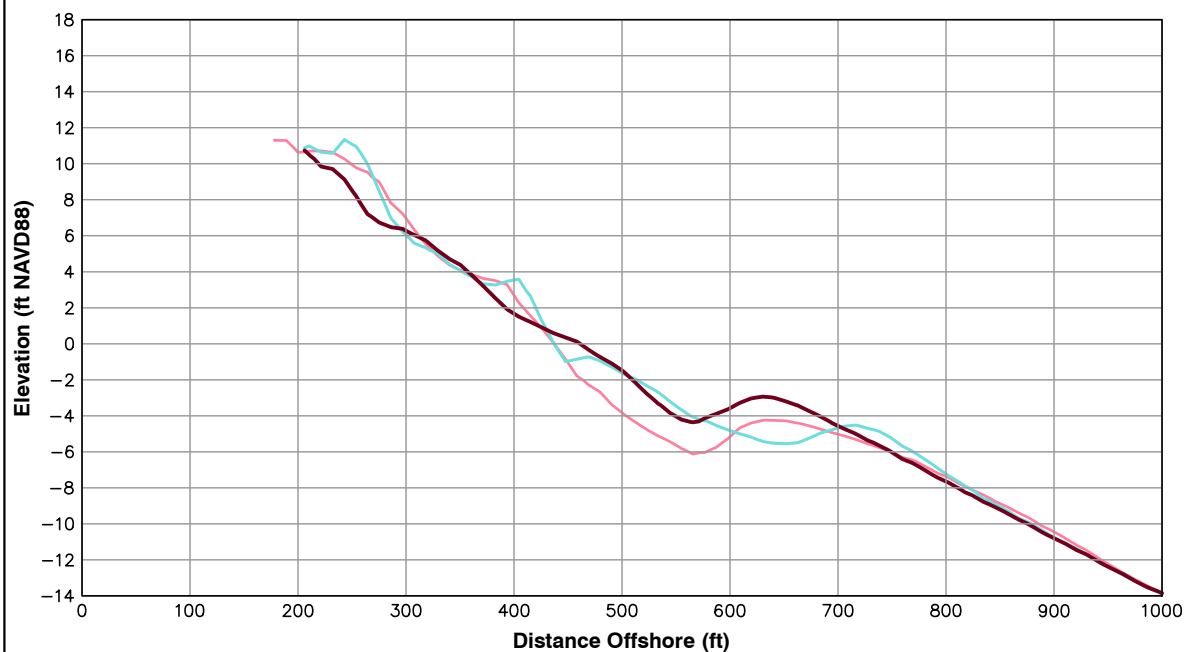
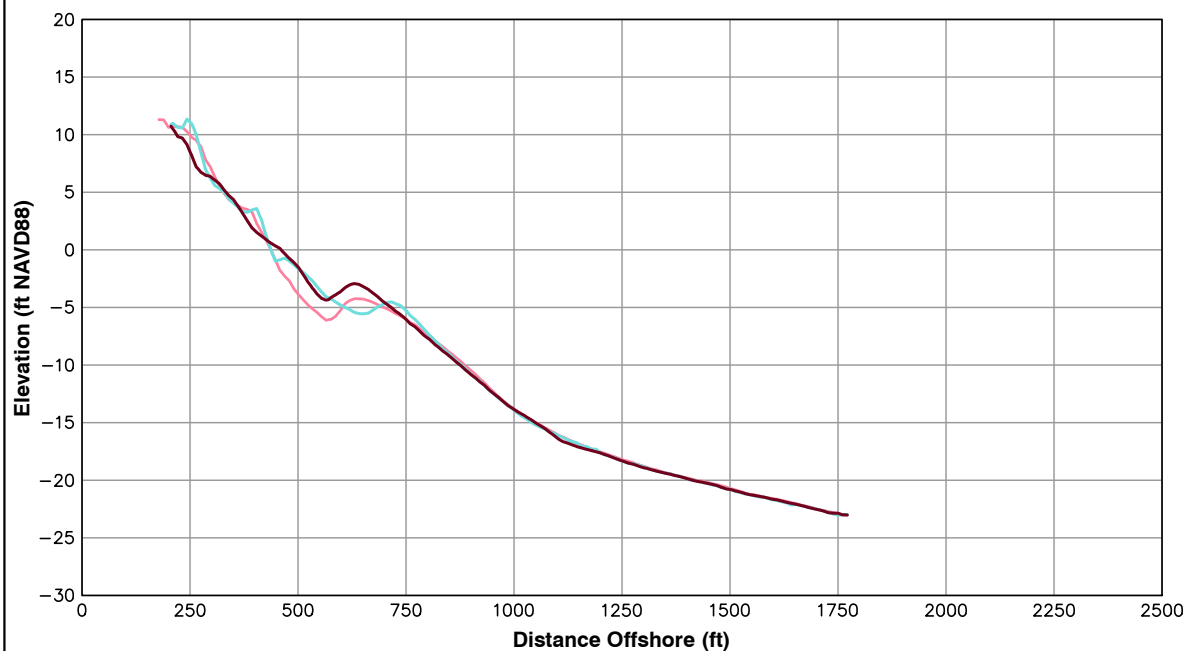
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 242+03

Pg 66 of 106

Fall 2013





Survey Transect 252+62	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-0.61 ft/yr	-5.12 ft
Volume Change Above -15 ft NAVD88	7.16 cy/ft/yr	-1.53 cy/ft
Volume Change Above 0 ft NAVD88	-5.07 cy/ft/yr	-6.15 cy/ft

**LEGEND:**

2013 OCT  
 2013 APR  
 2012 SEP

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

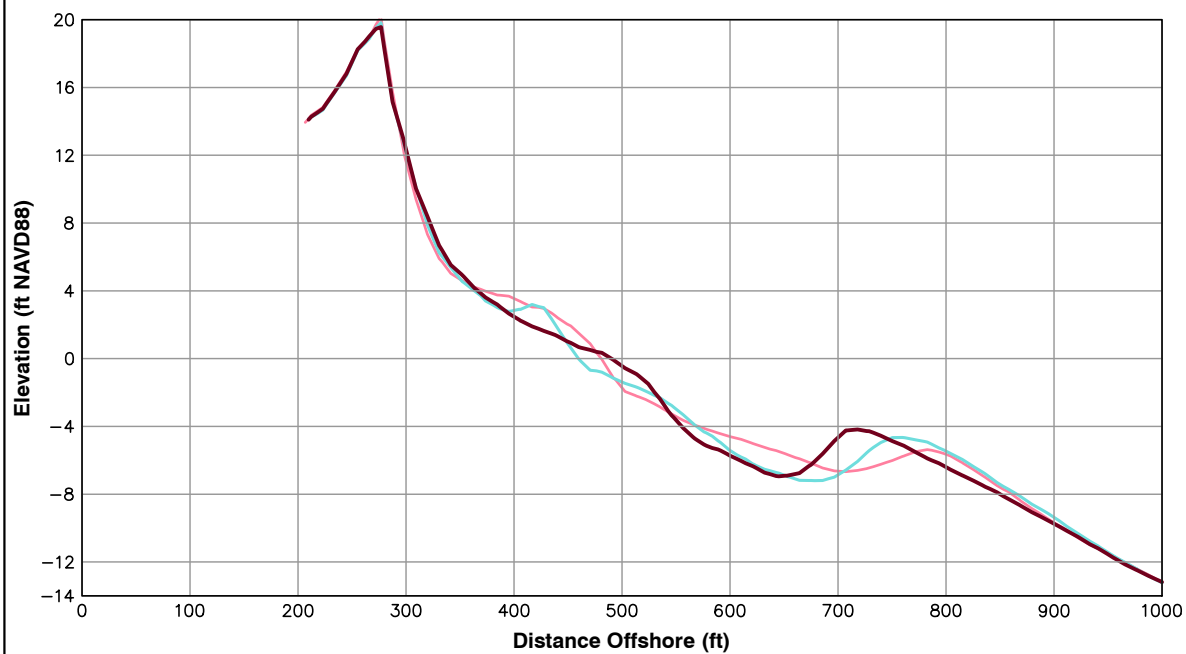
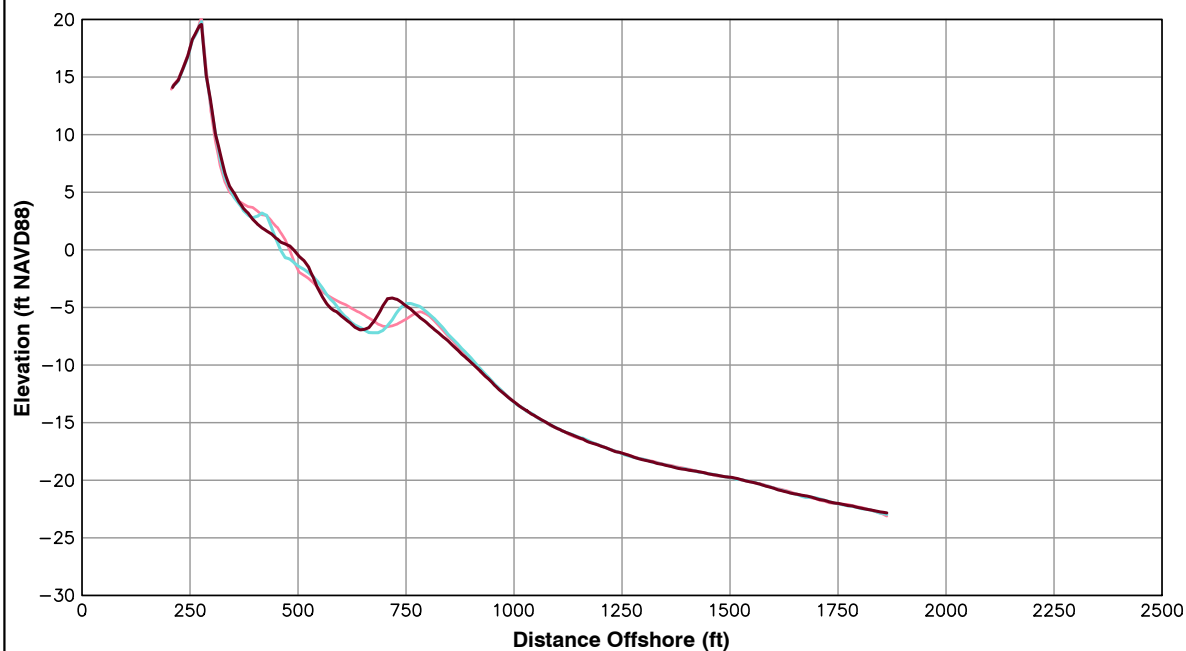


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 252+62**

**Pg 67 of 106**

**Fall 2013**



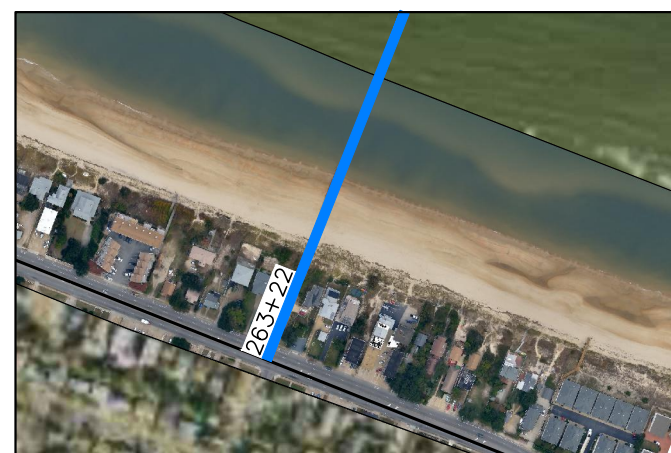
Survey Transect 263+22	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-17.24 ft/yr	1.88 ft
Volume Change Above -15 ft NAVD88	-2.13 cy/ft/yr	0.04 cy/ft
Volume Change Above 0 ft NAVD88	-2.27 cy/ft/yr	-0.06 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



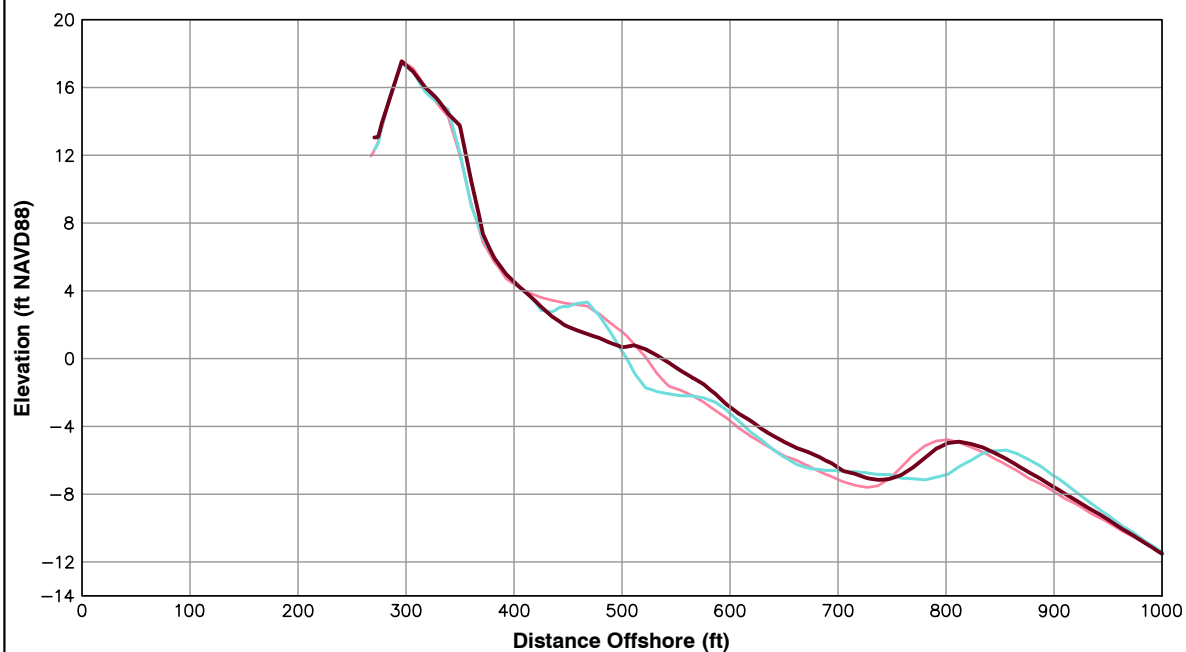
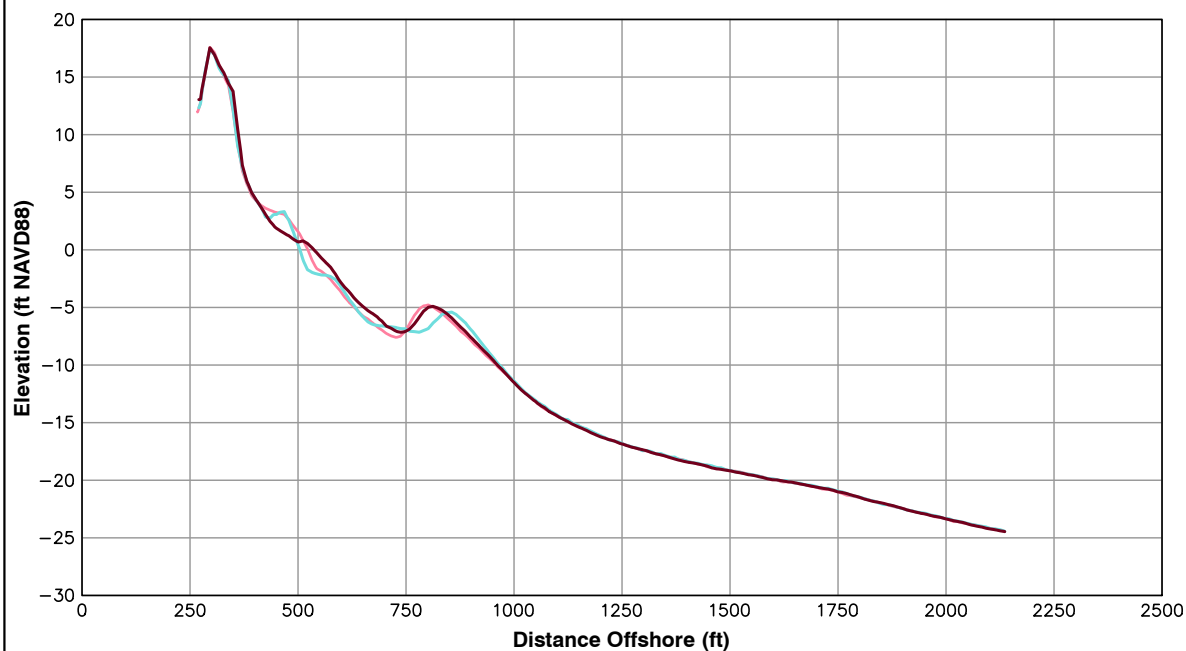
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 263+22

Pg 68 of 106

Fall 2013

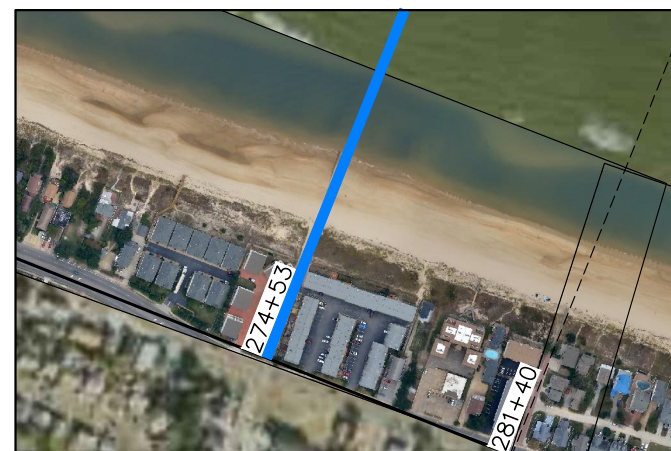


Survey Transect 274+53	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-20.70 ft/yr	-7.39 ft
Volume Change Above -15 ft NAVD88	5.15 cy/ft/yr	6.57 cy/ft
Volume Change Above 0 ft NAVD88	-1.64 cy/ft/yr	-0.27 cy/ft

LEGEND:	
2013 OCT	<span style="color: darkred;">—</span>
2013 APR	<span style="color: cyan;">—</span>
2012 SEP	<span style="color: pink;">—</span>

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

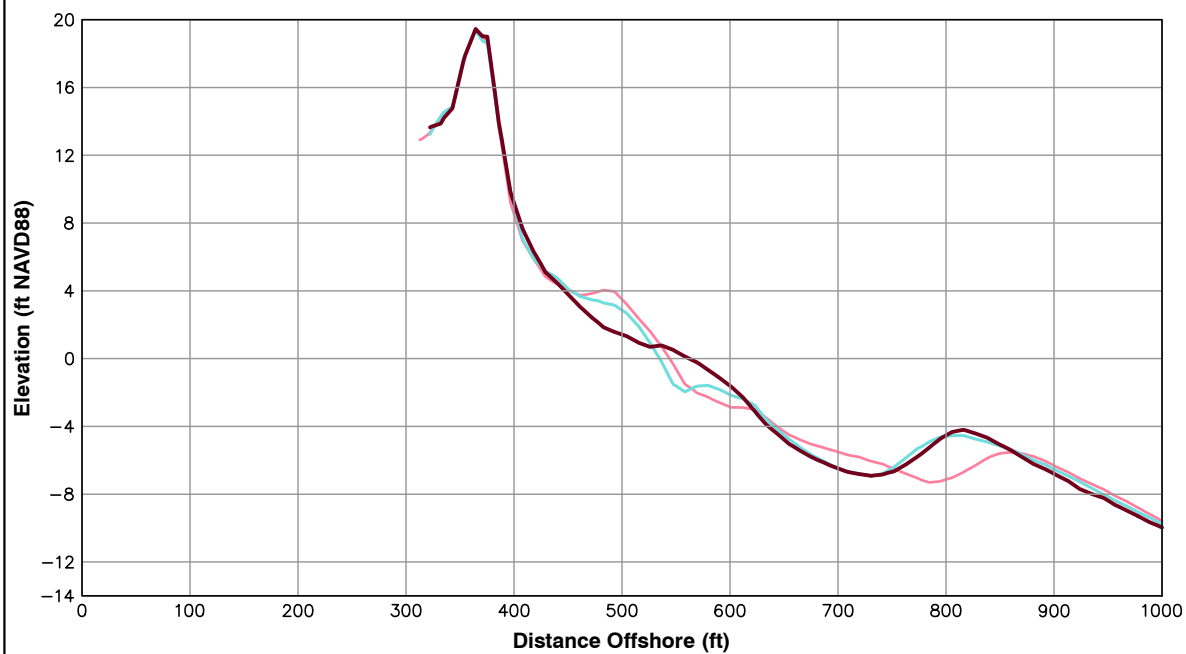
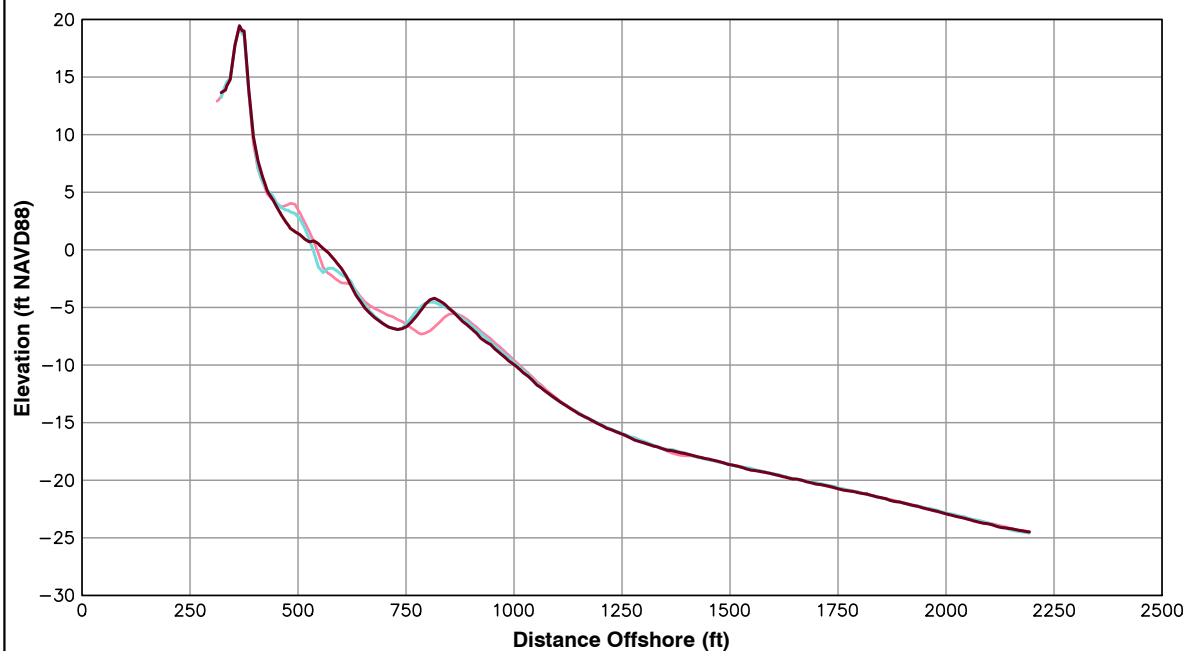
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 274+53

Pg 69 of 106

Fall 2013





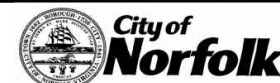
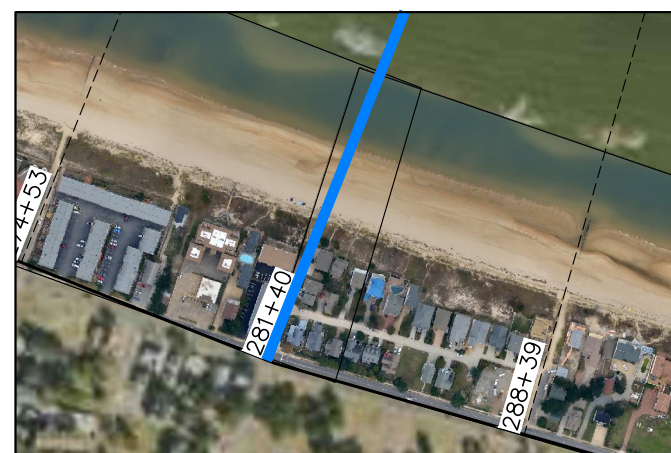
Survey Transect 281+40	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-18.02 ft/yr	-10.99 ft
Volume Change Above -15 ft NAVD88	-0.61 cy/ft/yr	-1.77 cy/ft
Volume Change Above 0 ft NAVD88	-3.07 cy/ft/yr	-2.11 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

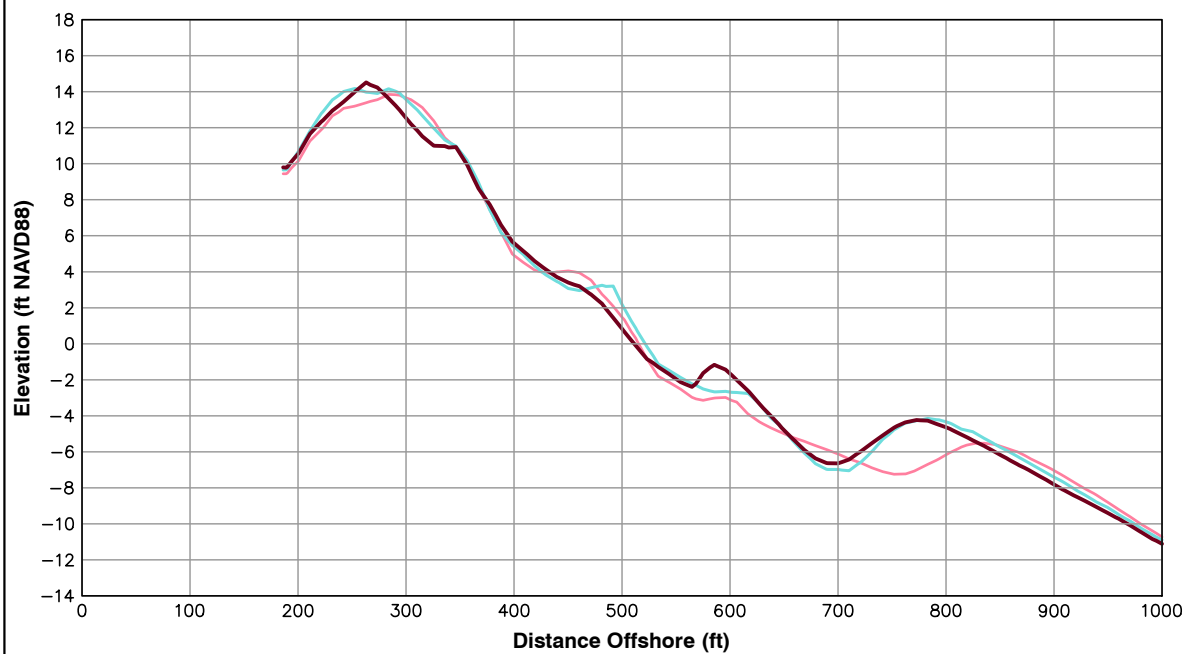
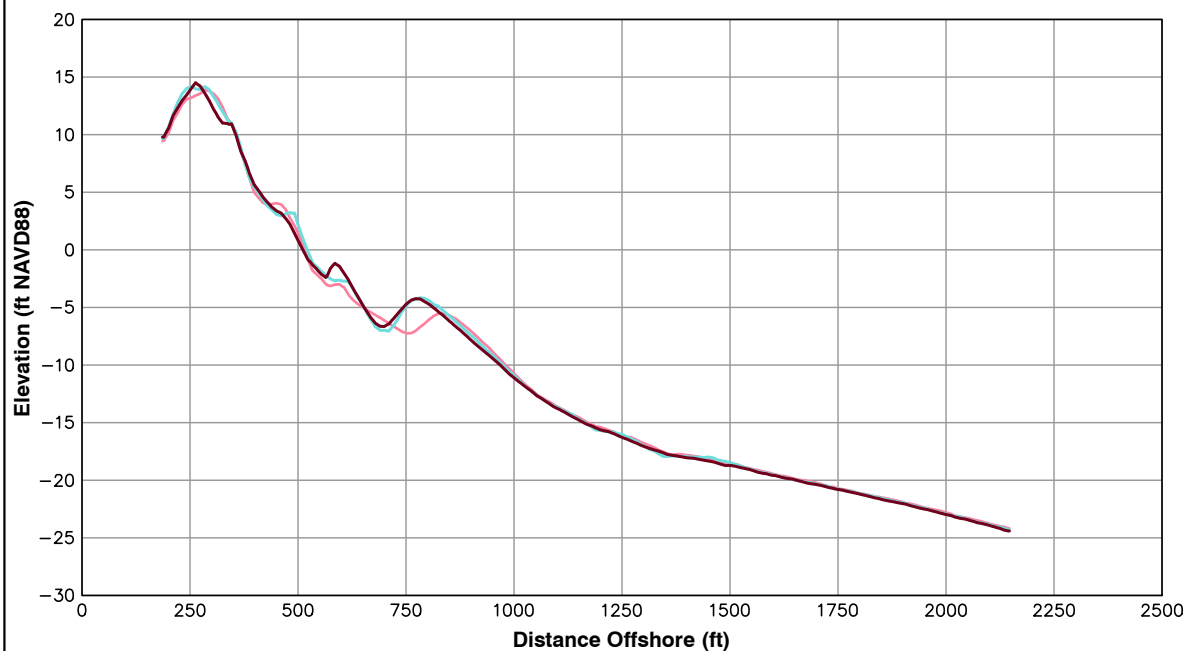


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 281+40

Pg 70 of 106

Fall 2013



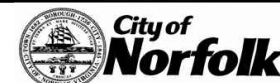
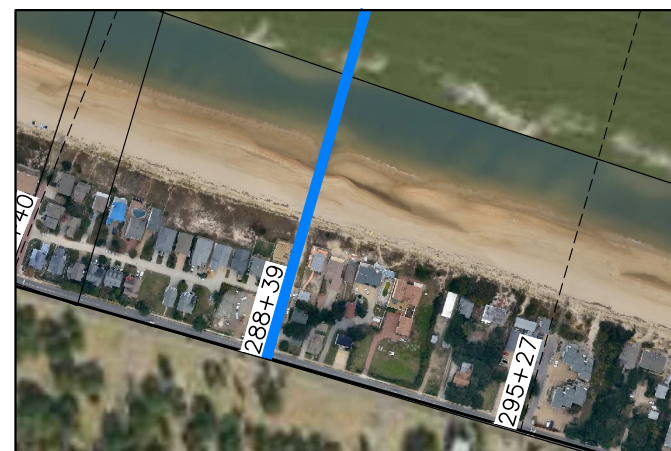
Survey Transect 288+39	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-7.20 ft/yr	-13.49 ft
Volume Change Above -15 ft NAVD88	4.38 cy/ft/yr	-4.49 cy/ft
Volume Change Above 0 ft NAVD88	-1.06 cy/ft/yr	-3.70 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

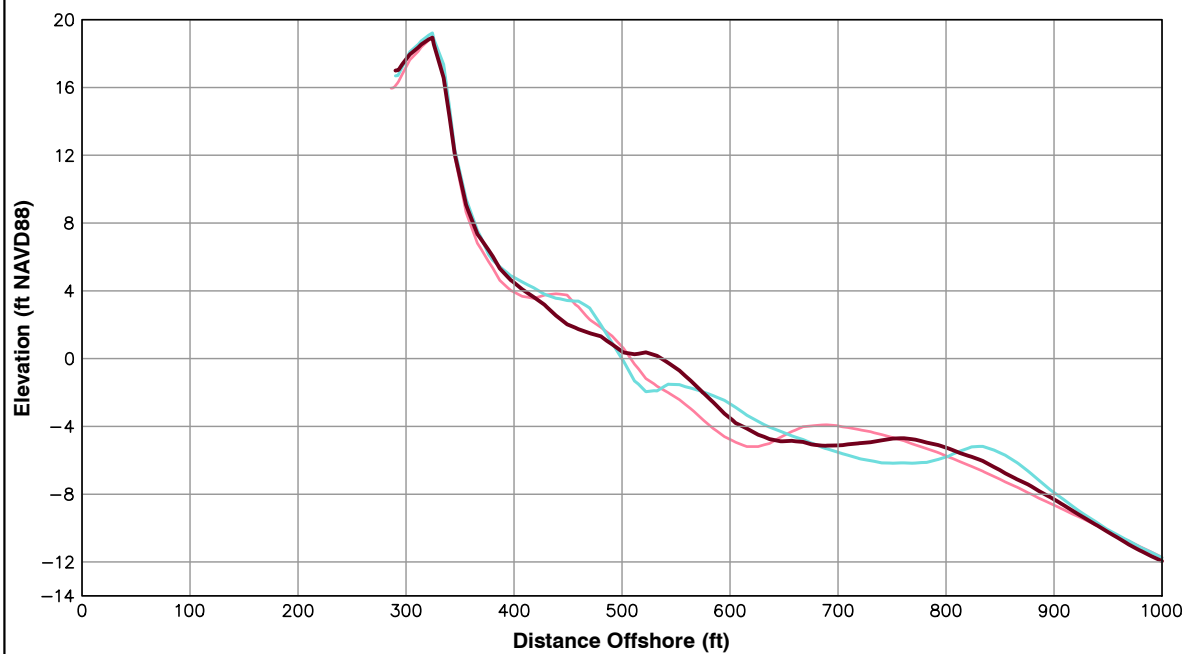
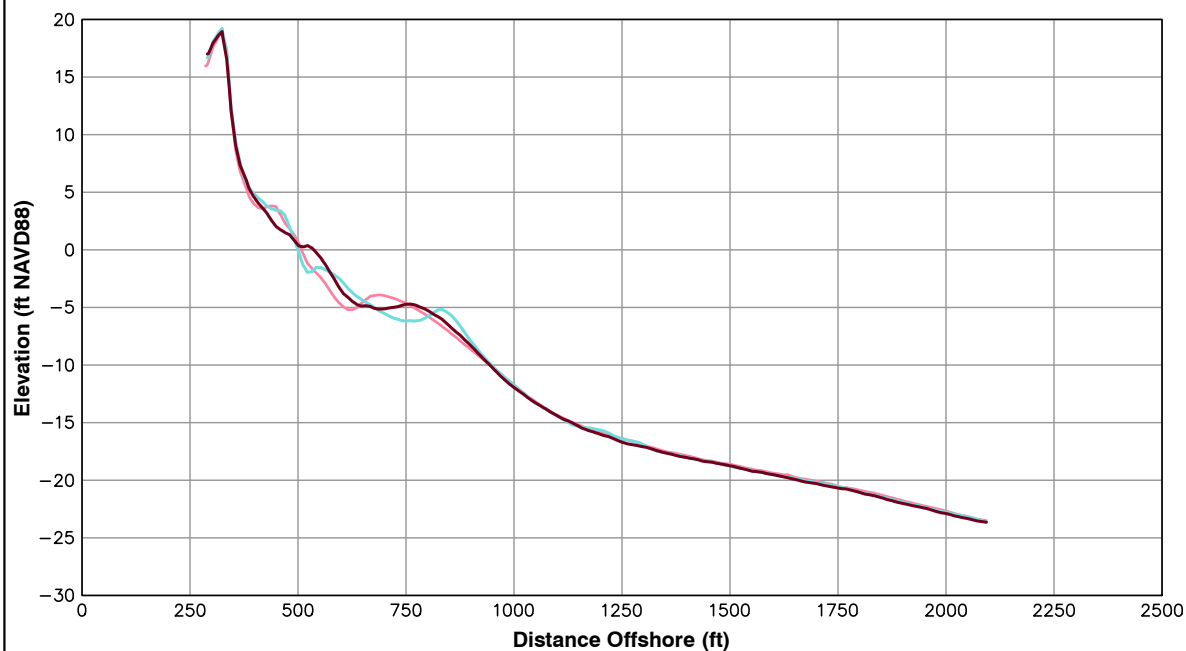


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 288+39

Pg 71 of 106

Fall 2013



Survey Transect 295+27	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-7.83 ft/yr	-2.64 ft
Volume Change Above -15 ft NAVD88	3.83 cy/ft/yr	-1.55 cy/ft
Volume Change Above 0 ft NAVD88	-0.75 cy/ft/yr	-3.41 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



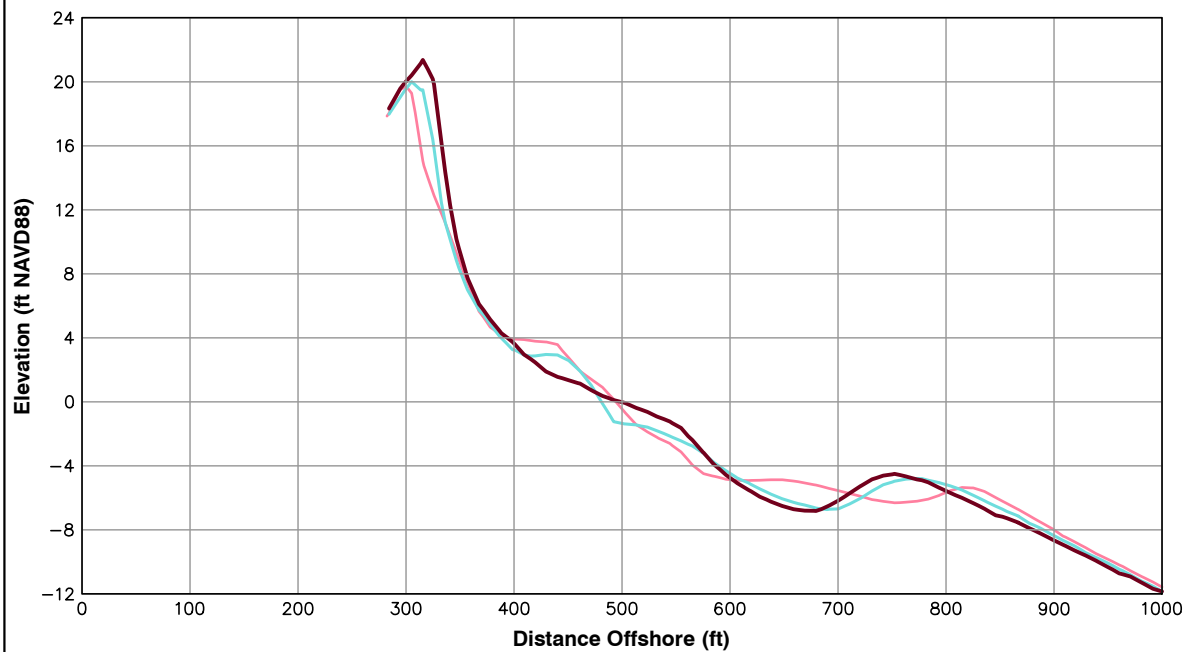
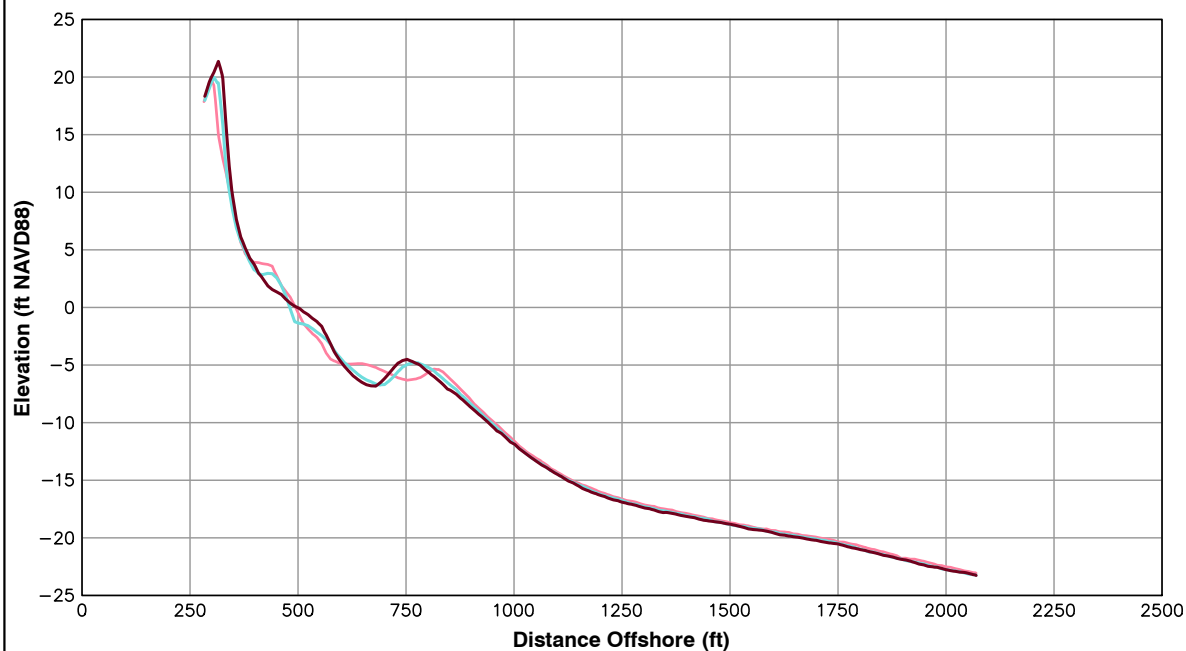
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 295+27

Pg 72 of 106

Fall 2013





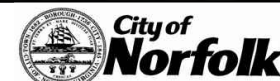
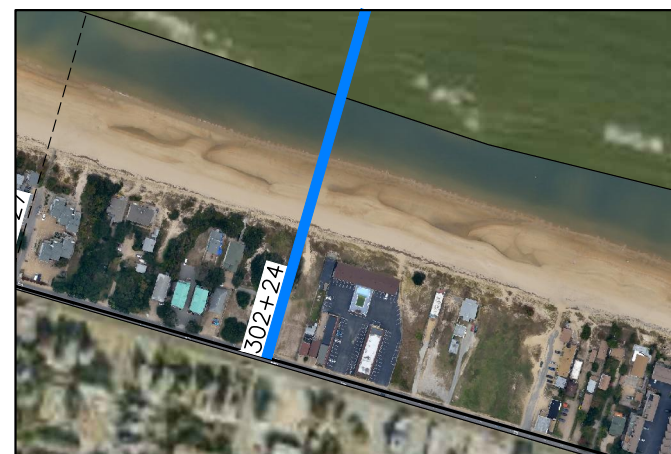
Survey Transect 302+24	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-14.36 ft/yr	-6.83 ft
Volume Change Above -15 ft NAVD88	1.50 cy/ft/yr	4.05 cy/ft
Volume Change Above 0 ft NAVD88	3.65 cy/ft/yr	3.53 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

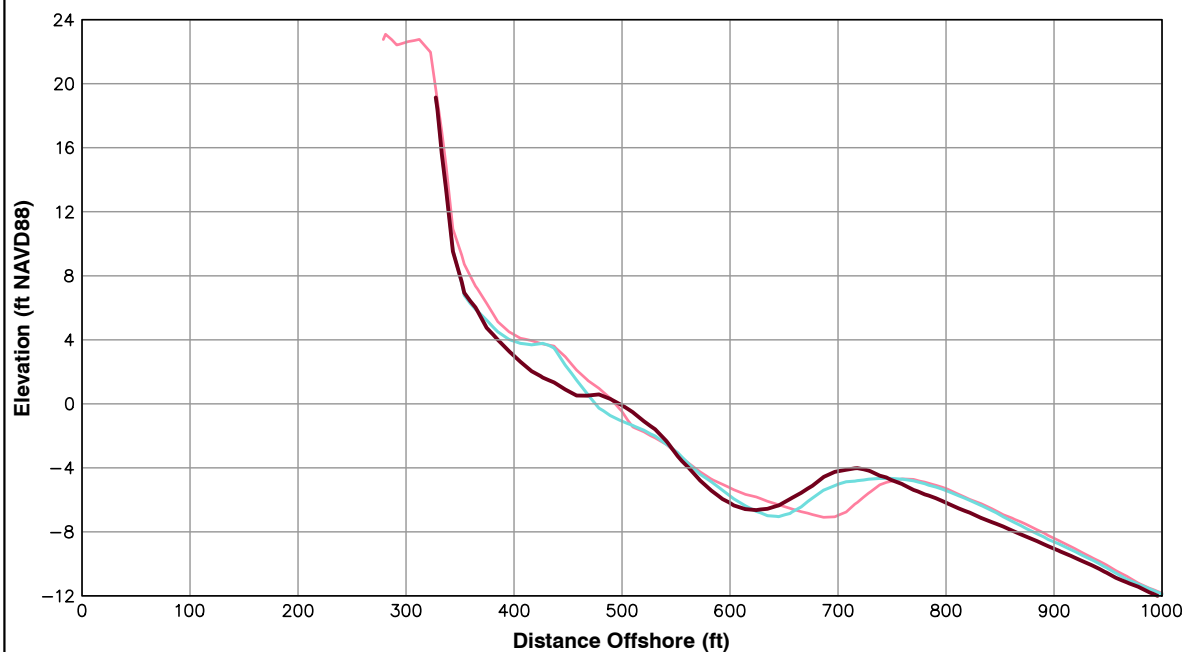
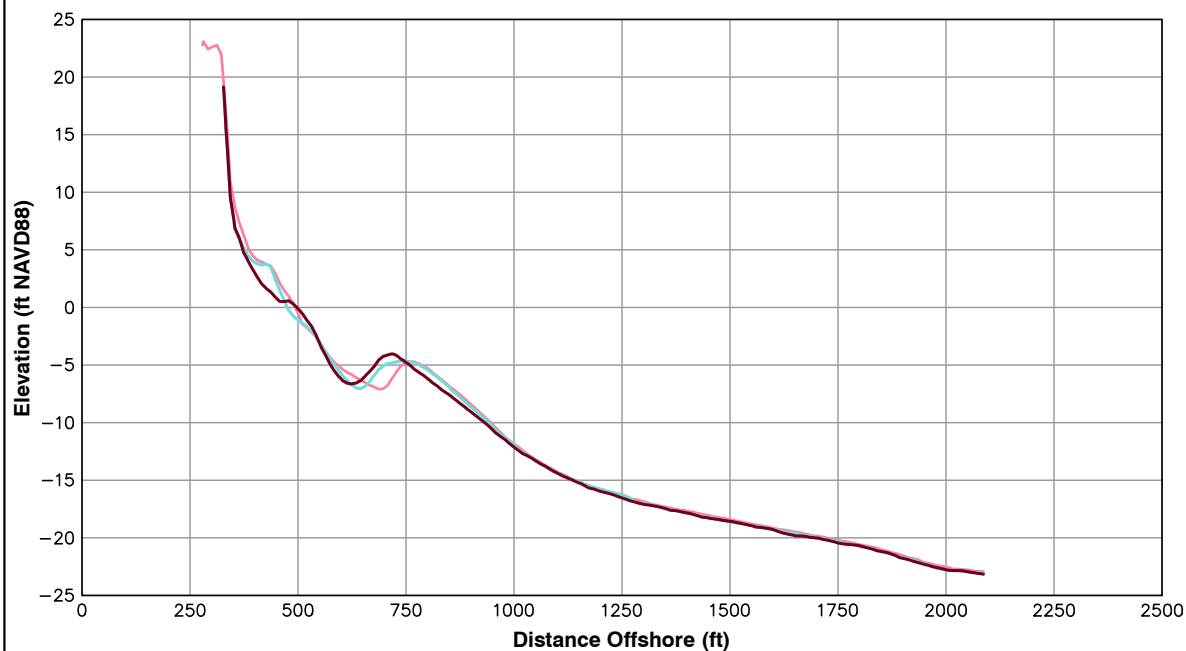


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 302+24

Pg 73 of 106

Fall 2013



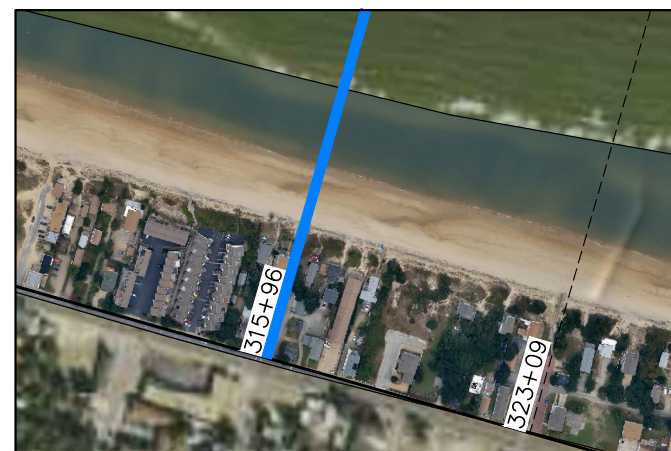
Survey Transect 315+96	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-31.14 ft/yr	-18.15 ft
Volume Change Above -15 ft NAVD88	-9.63 cy/ft/yr	-5.17 cy/ft
Volume Change Above 0 ft NAVD88	-8.10 cy/ft/yr	-3.92 cy/ft

**LEGEND:**

2013 OCT  
 2013 APR  
 2012 SEP

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



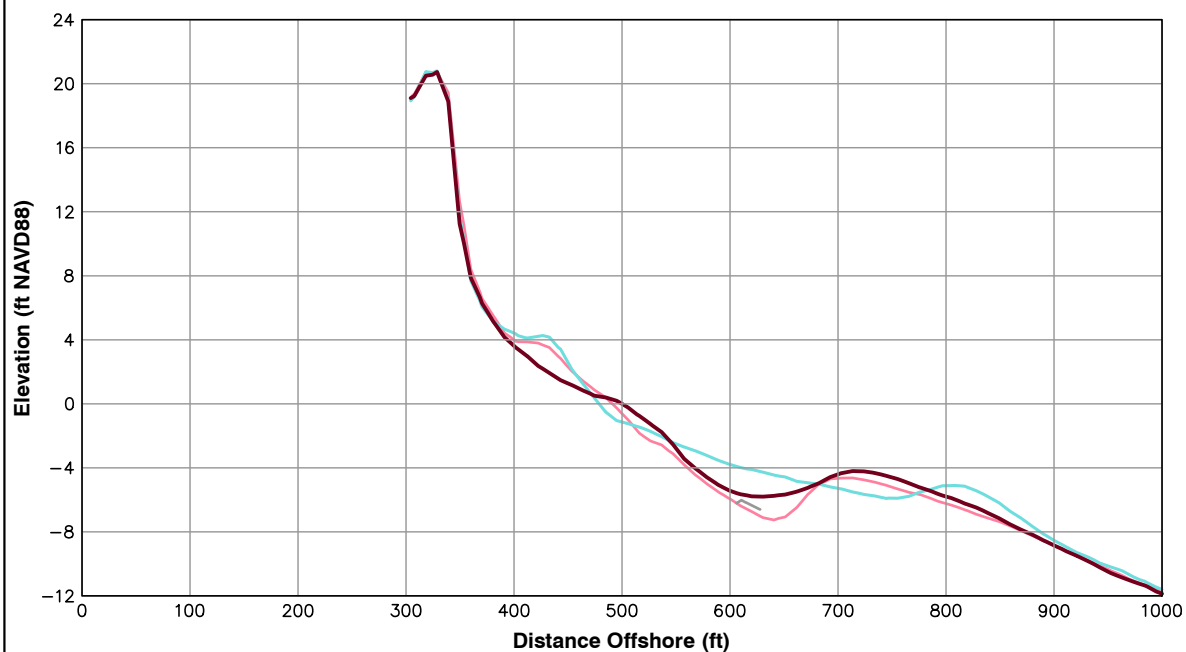
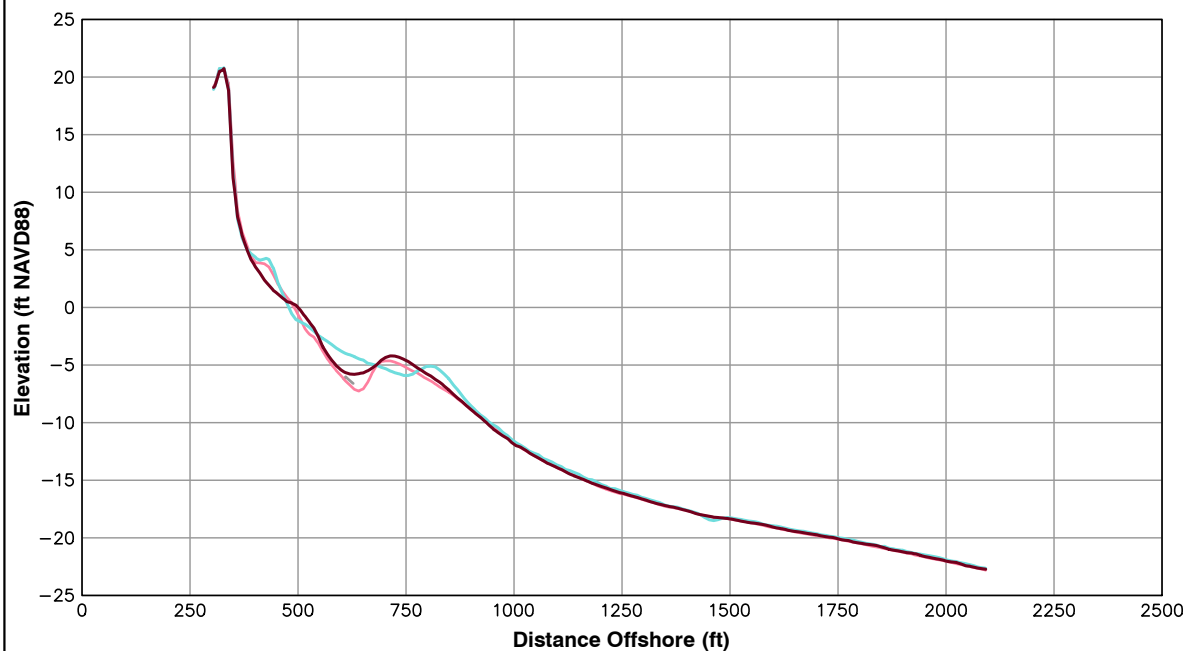
**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 315+96**

**Pg 74 of 106**

**Fall 2013**



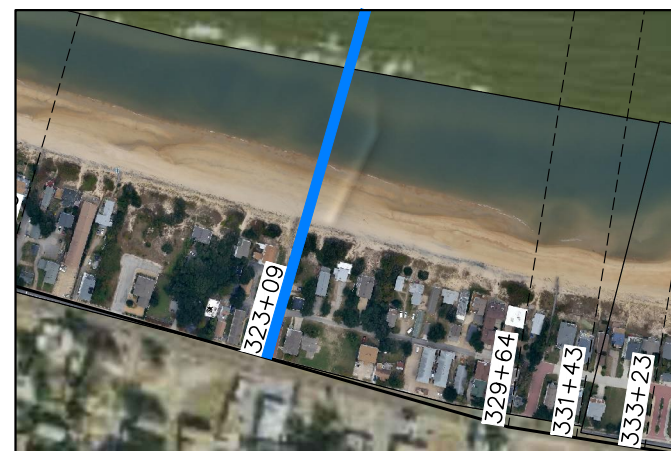
Survey Transect 323+09	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-12.27 ft/yr	-7.62 ft
Volume Change Above -15 ft NAVD88	3.43 cy/ft/yr	-9.87 cy/ft
Volume Change Above 0 ft NAVD88	-3.99 cy/ft/yr	-3.66 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

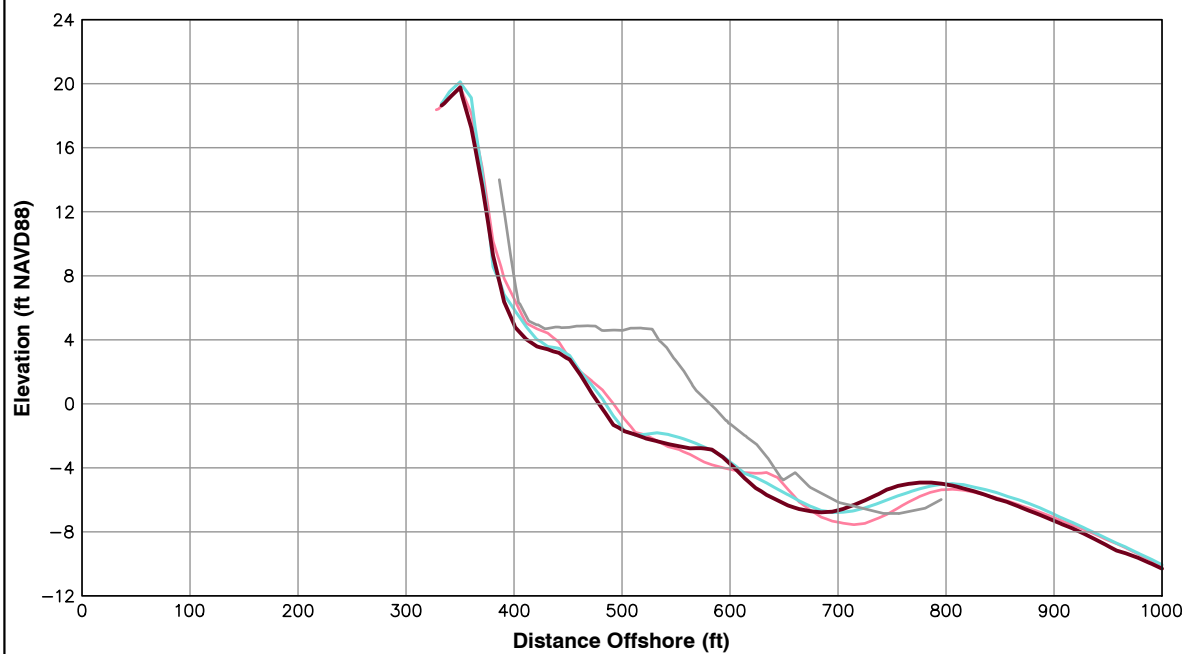
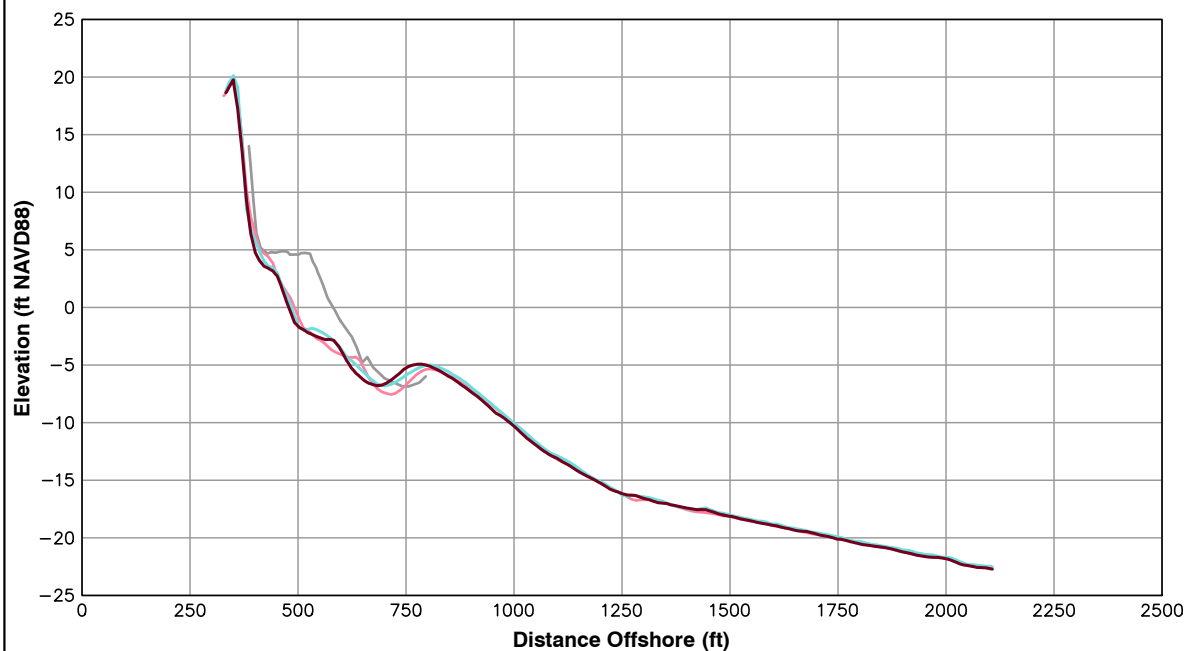
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 323+09

Pg 75 of 106

Fall 2013





Survey Transect 329+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-10.23 ft/yr	-5.05 ft
Volume Change Above -15 ft NAVD88	-3.14 cy/ft/yr	-8.37 cy/ft
Volume Change Above 0 ft NAVD88	-4.24 cy/ft/yr	-2.70 cy/ft

LEGEND:	
2013 OCT	<span style="color: darkred;">—</span>
2013 APR	<span style="color: cyan;">—</span>
2012 SEP	<span style="color: magenta;">—</span>
POST-FILL	<span style="color: grey;">—</span>

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

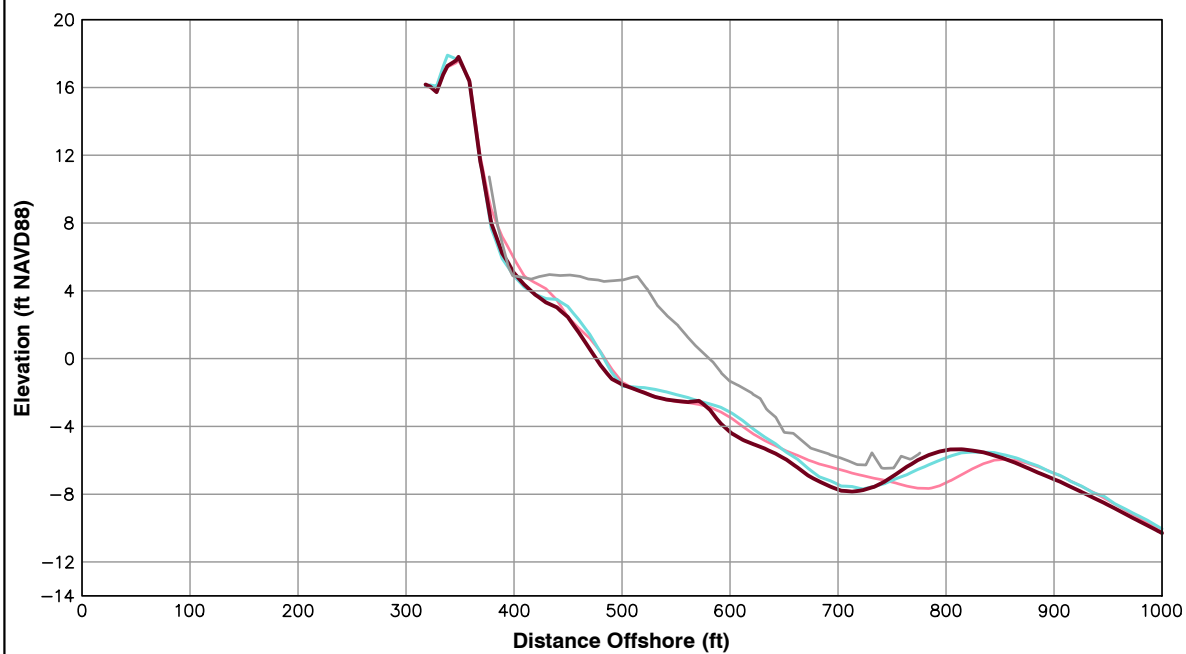
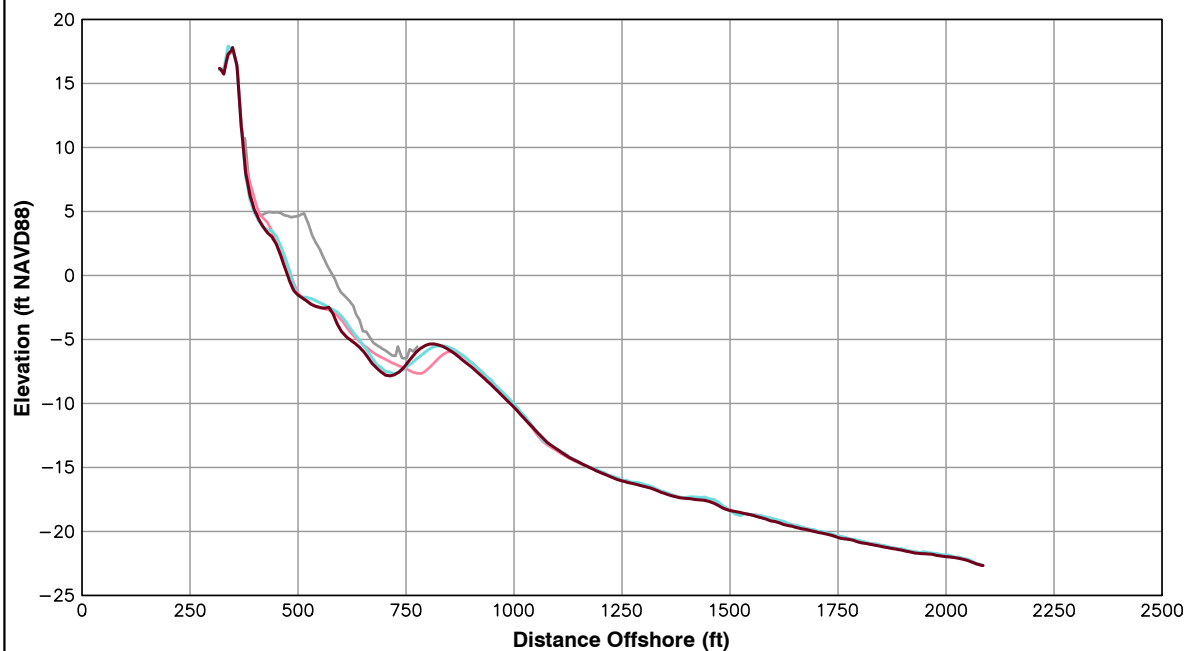


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 329+63

Pg 76 of 106

Fall 2013



Survey Transect 331+43	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-6.73 ft/yr	-8.56 ft
Volume Change Above -15 ft NAVD88	-3.16 cy/ft/yr	-6.26 cy/ft
Volume Change Above 0 ft NAVD88	-2.29 cy/ft/yr	-1.19 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

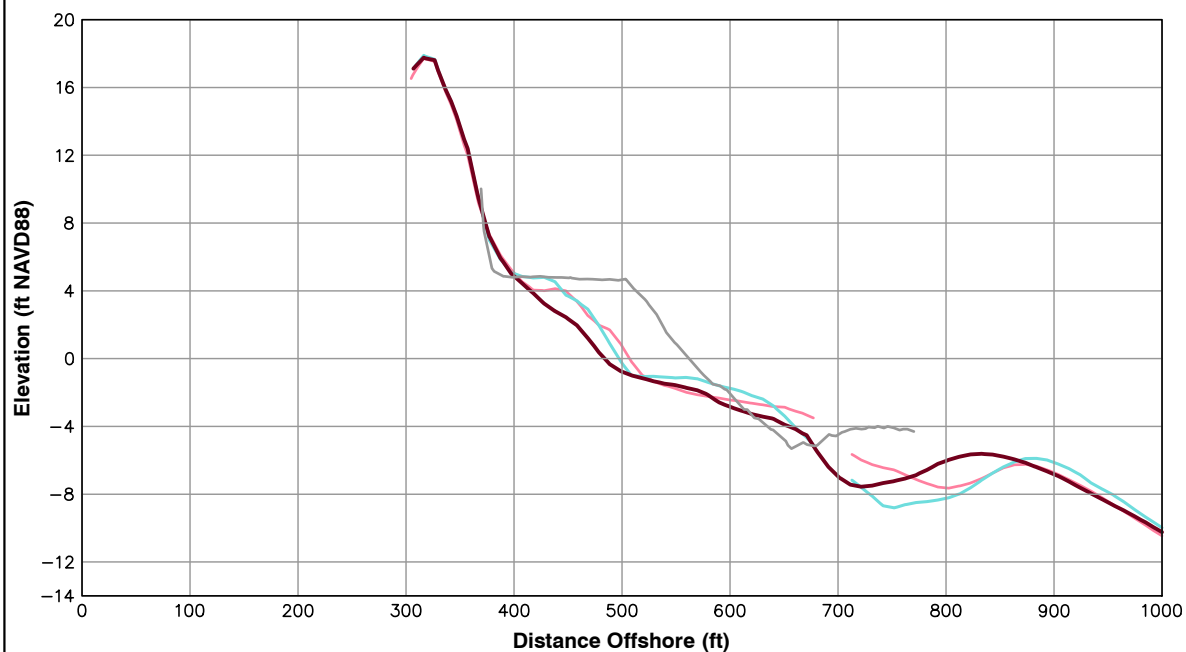
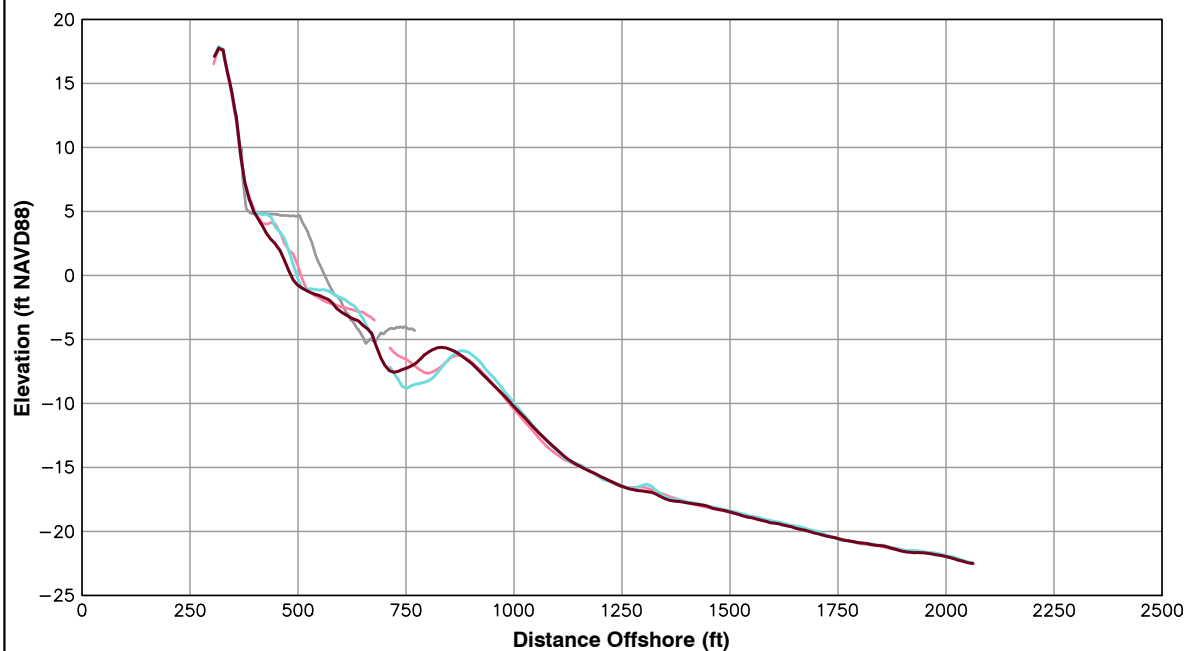


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 331+43

Pg 77 of 106

Fall 2013



Survey Transect 333+23	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-24.73 ft/yr	-16.52 ft
Volume Change Above -15 ft NAVD88	-2.80 cy/ft/yr	-3.49 cy/ft
Volume Change Above 0 ft NAVD88	-3.58 cy/ft/yr	-4.30 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



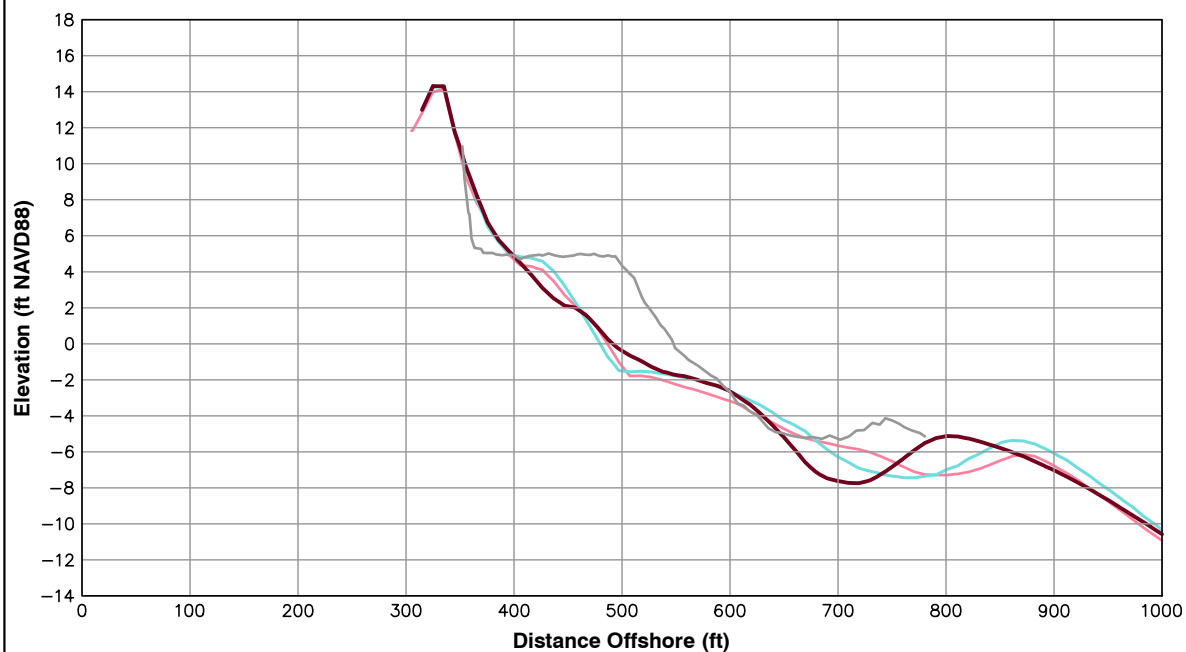
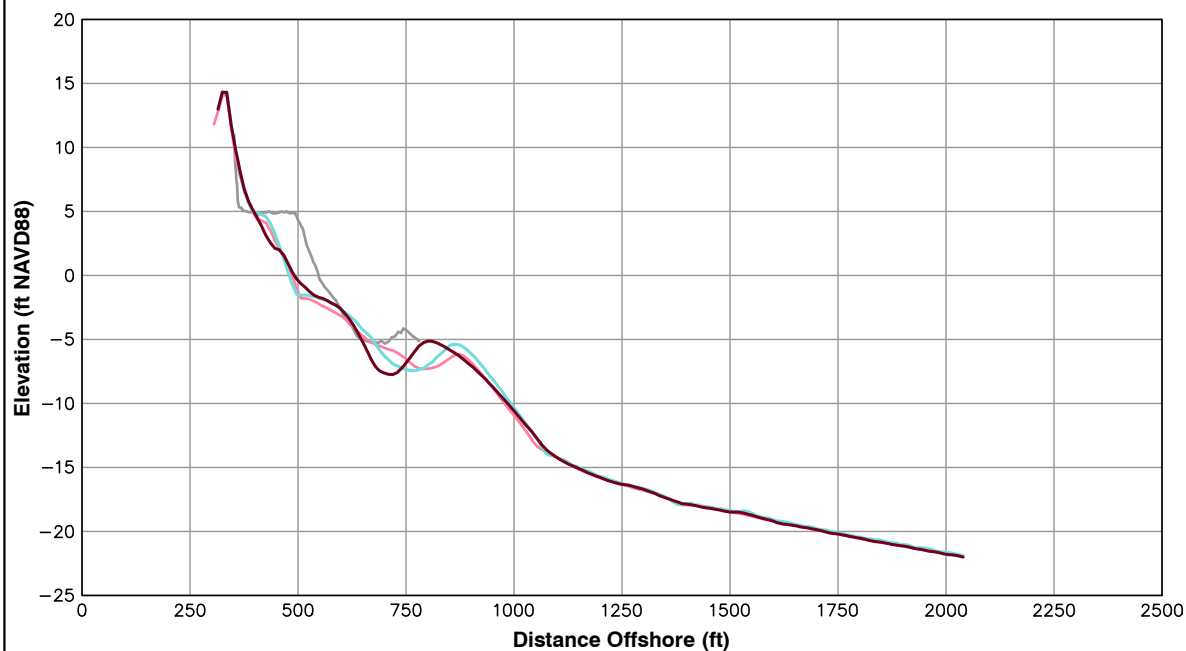
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 333+23

Pg 78 of 106

Fall 2013





Survey Transect 335+03	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	0.57 ft/yr	6.19 ft
Volume Change Above -15 ft NAVD88	3.79 cy/ft/yr	-3.90 cy/ft
Volume Change Above 0 ft NAVD88	-0.32 cy/ft/yr	-1.44 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

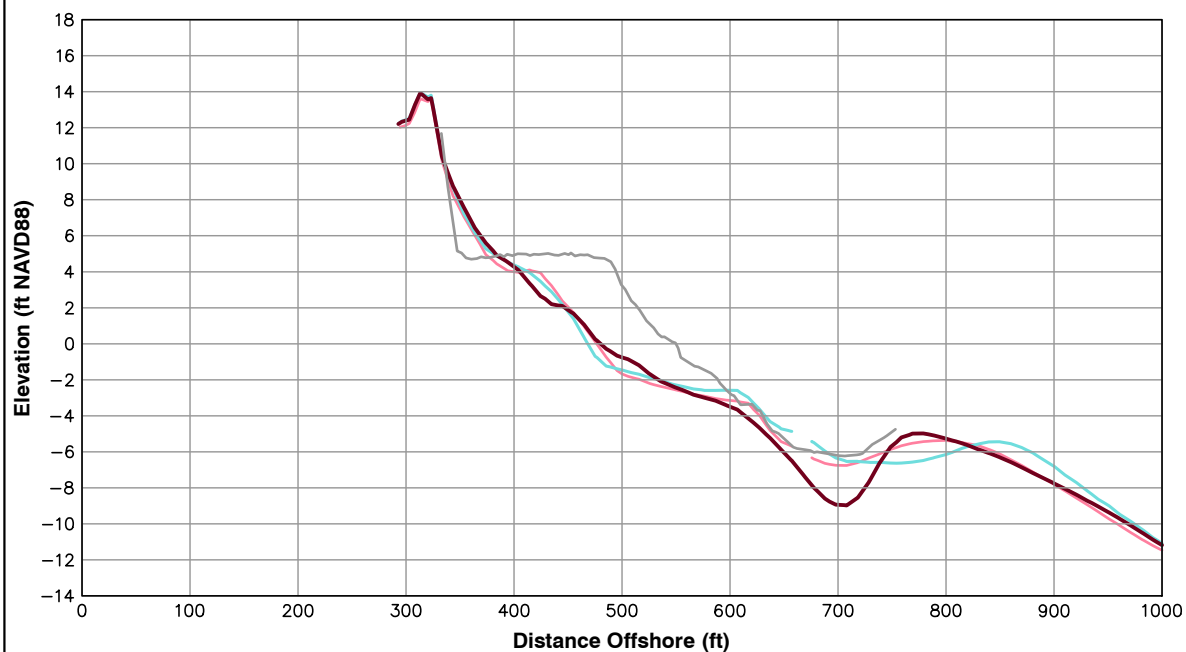
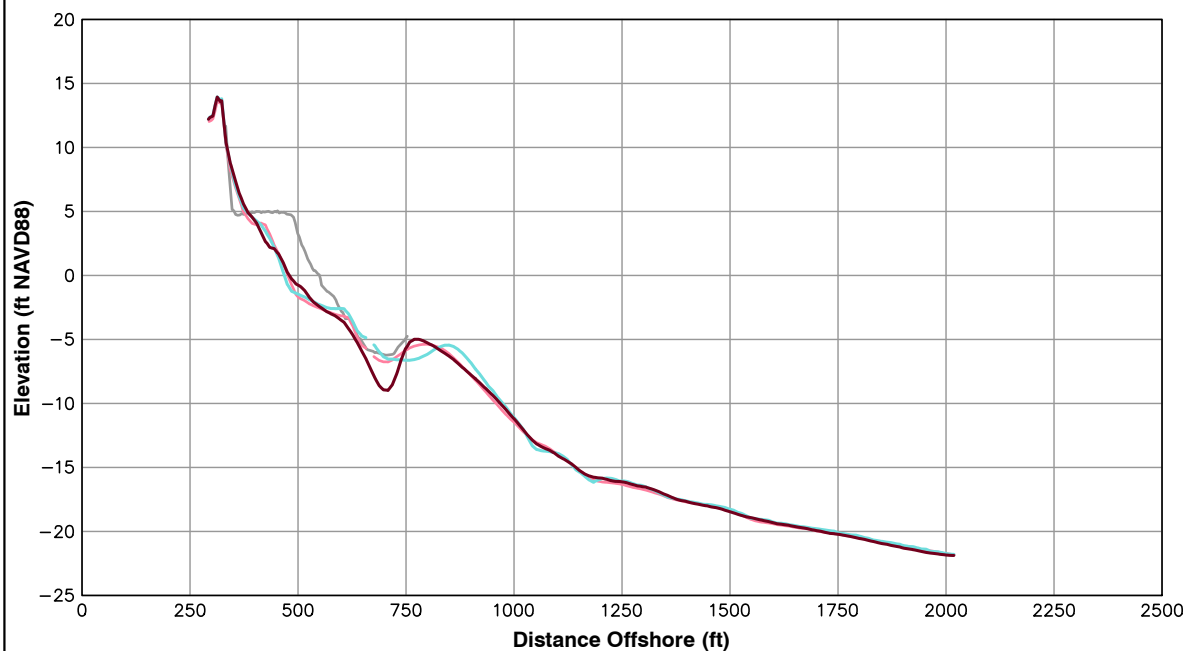


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 335+03

Pg 79 of 106

Fall 2013



Survey Transect 336+83	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	1.23 ft/yr	7.07 ft
Volume Change Above -15 ft NAVD88	-2.26 cy/ft/yr	-7.14 cy/ft
Volume Change Above 0 ft NAVD88	0.38 cy/ft/yr	-0.06 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

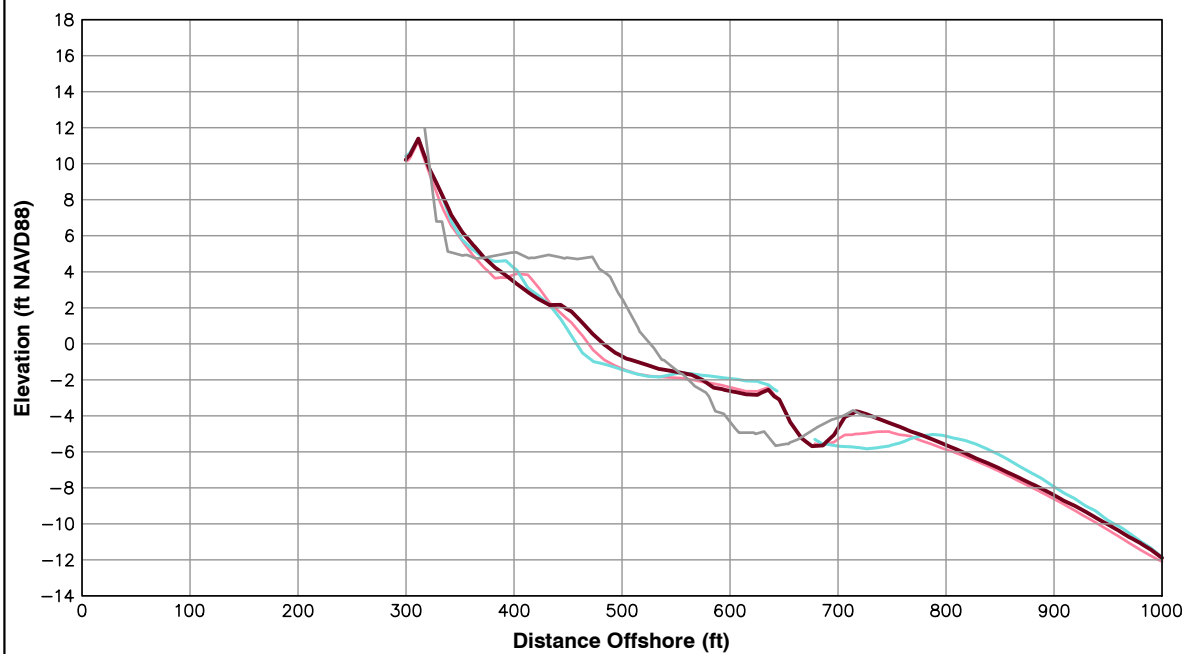
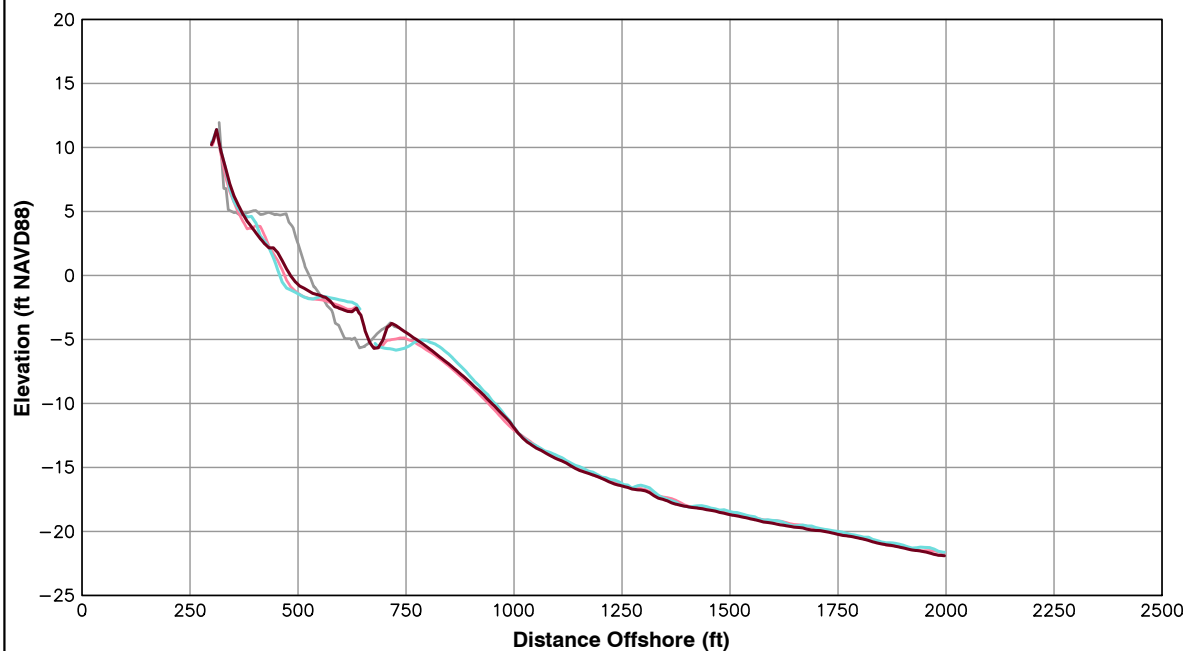


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 336+83

Pg 80 of 106

Fall 2013



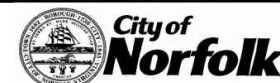
Survey Transect 338+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	9.69 ft/yr	18.68 ft
Volume Change Above -15 ft NAVD88	6.47 cy/ft/yr	0.84 cy/ft
Volume Change Above 0 ft NAVD88	1.50 cy/ft/yr	0.95 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



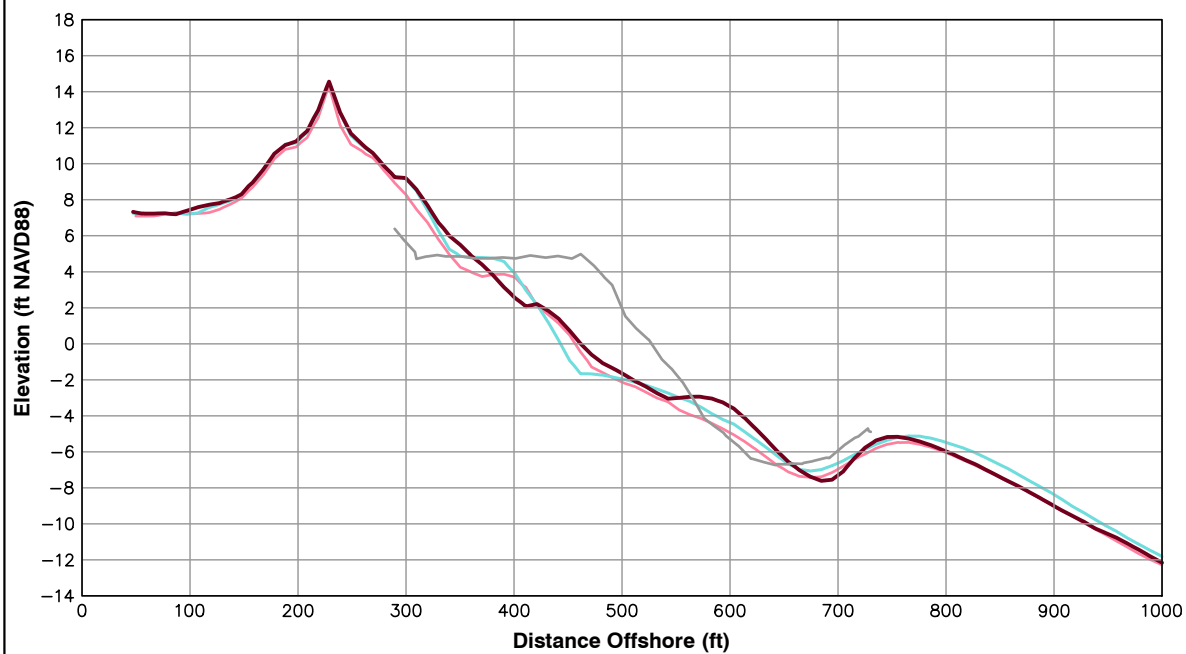
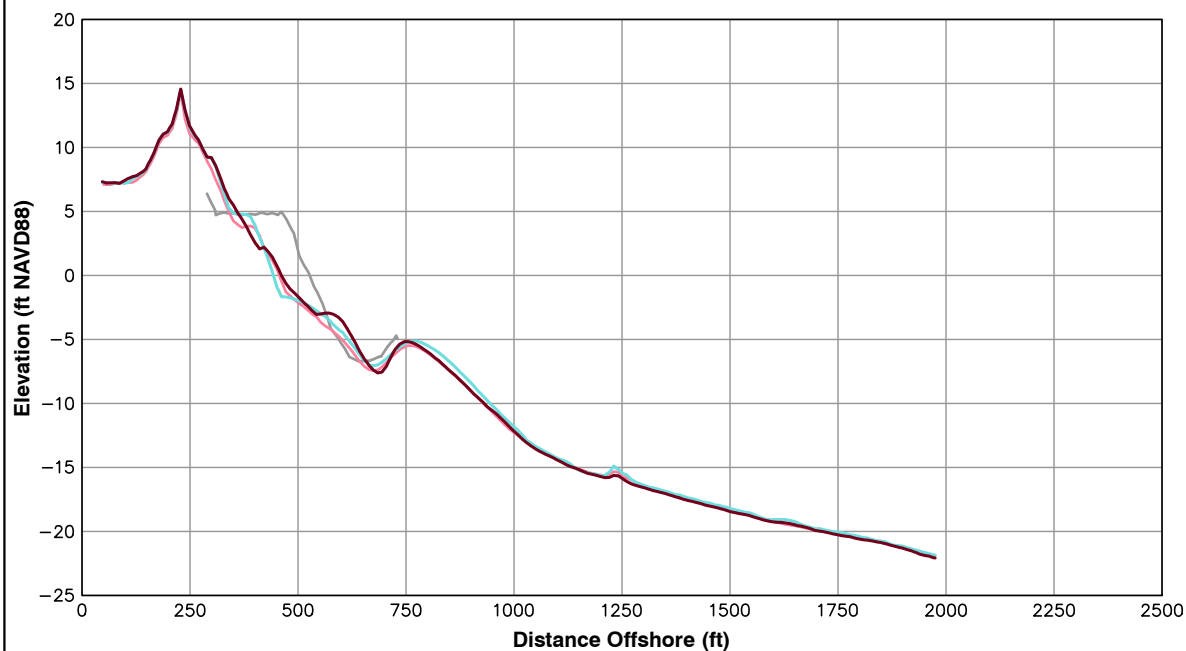
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 338+63

Pg 81 of 106

Fall 2013





Survey Transect 340+43	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	3.83 ft/yr	13.93 ft
Volume Change Above -15 ft NAVD88	10.73 cy/ft/yr	-1.90 cy/ft
Volume Change Above 0 ft NAVD88	4.54 cy/ft/yr	0.57 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

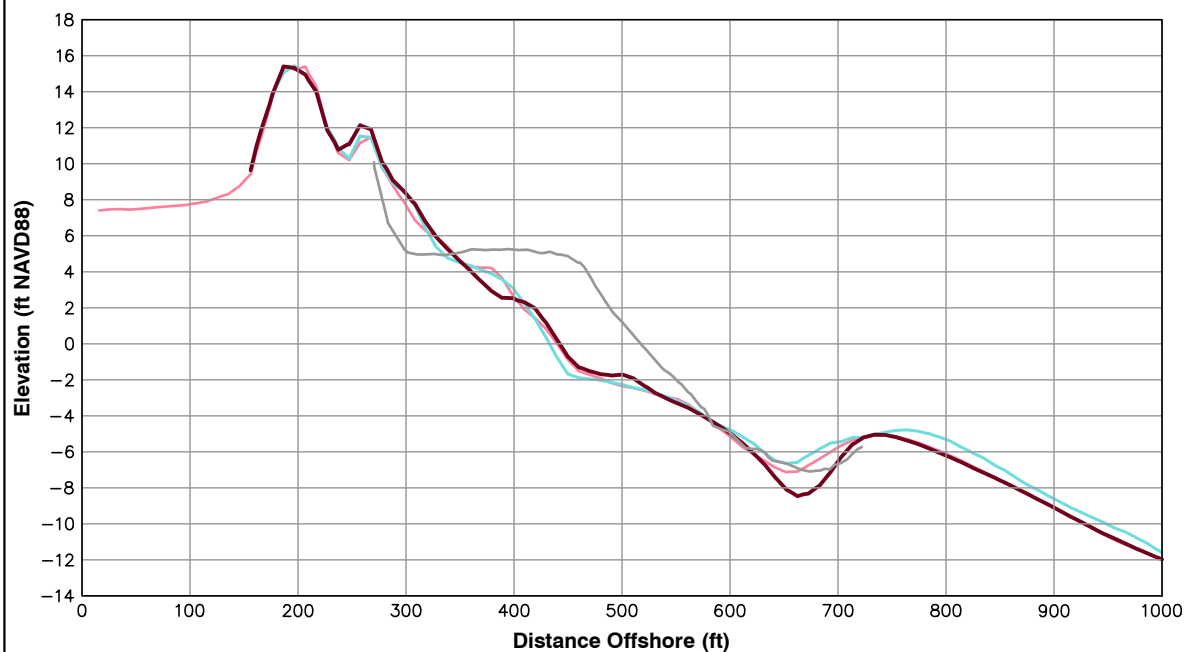
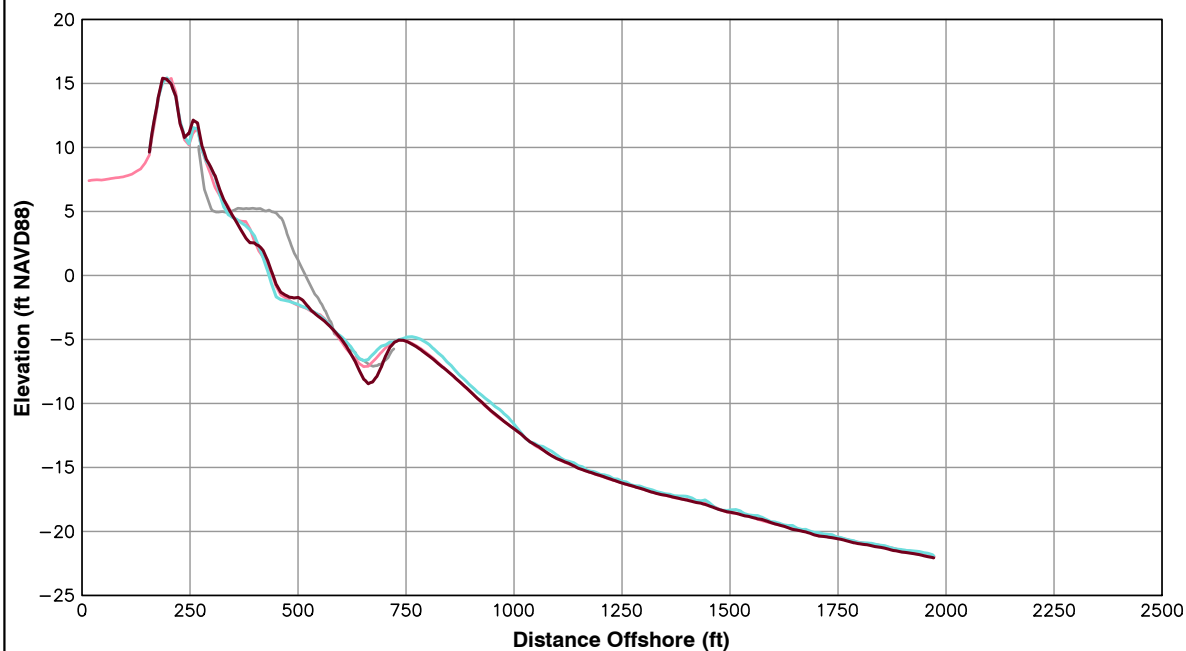


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 340+43**

**Pg 82 of 106**

**Fall 2013**



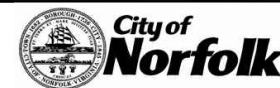
Survey Transect 342+23	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	4.50 ft/yr	8.40 ft
Volume Change Above -15 ft NAVD88	-0.85 cy/ft/yr	-9.42 cy/ft
Volume Change Above 0 ft NAVD88	1.05 cy/ft/yr	0.87 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

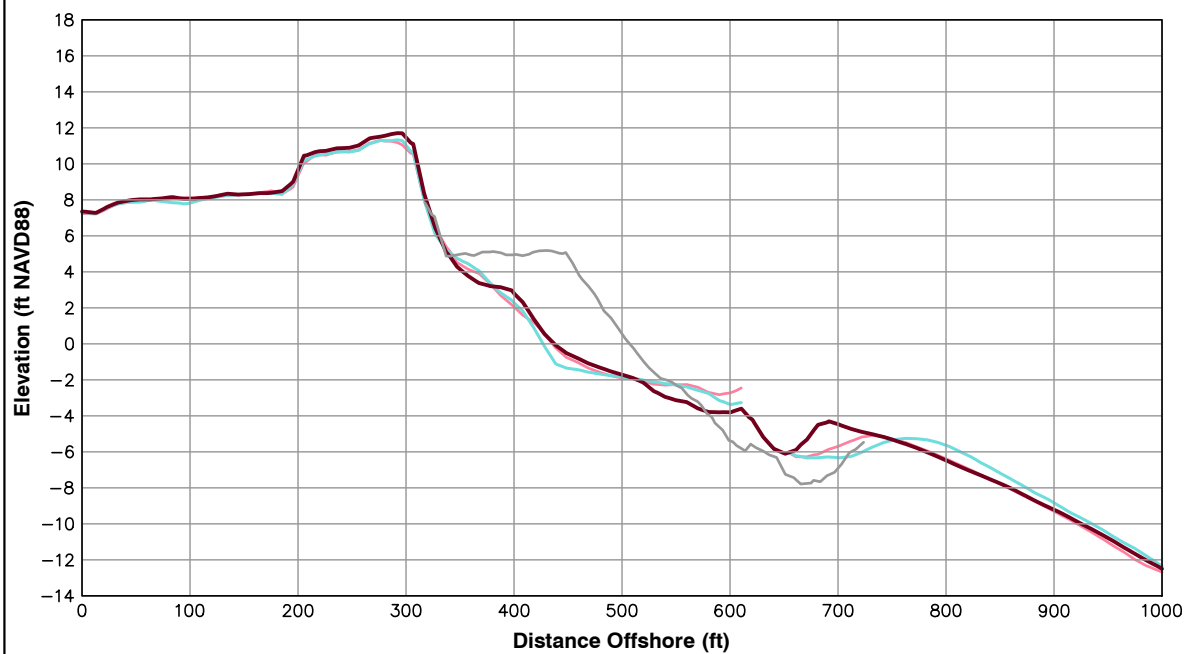
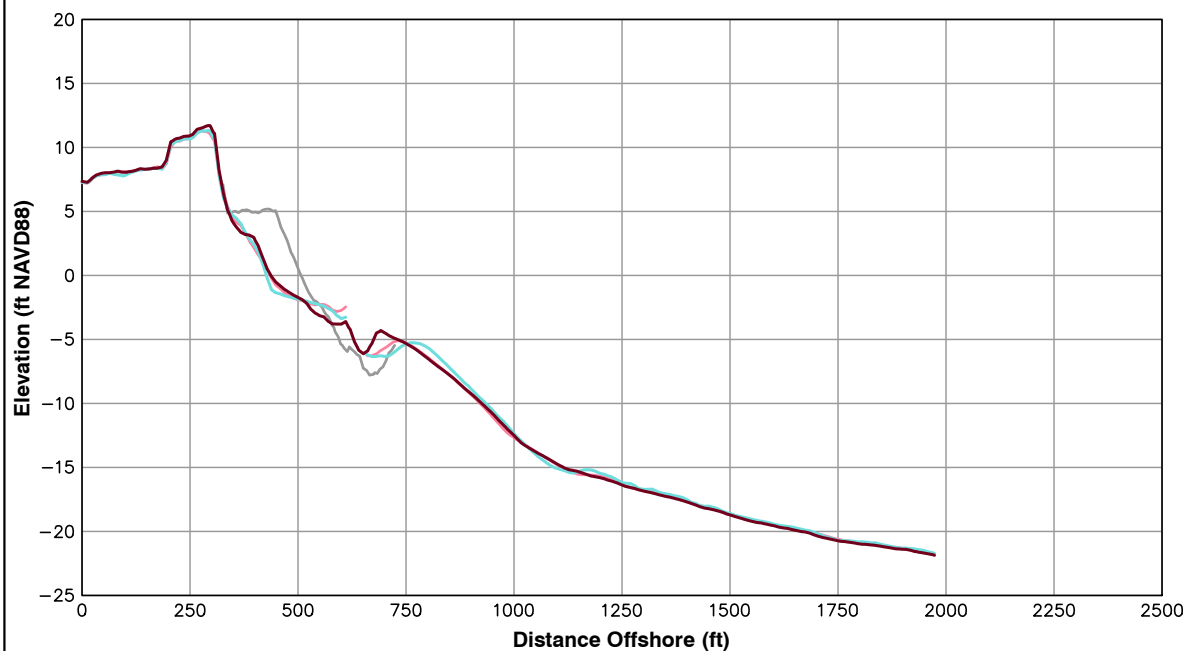


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 342+23

Pg 83 of 106

Fall 2013



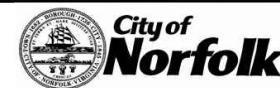
Survey Transect 344+05	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	1.11 ft/yr	5.69 ft
Volume Change Above -15 ft NAVD88	2.80 cy/ft/yr	1.77 cy/ft
Volume Change Above 0 ft NAVD88	1.94 cy/ft/yr	2.30 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



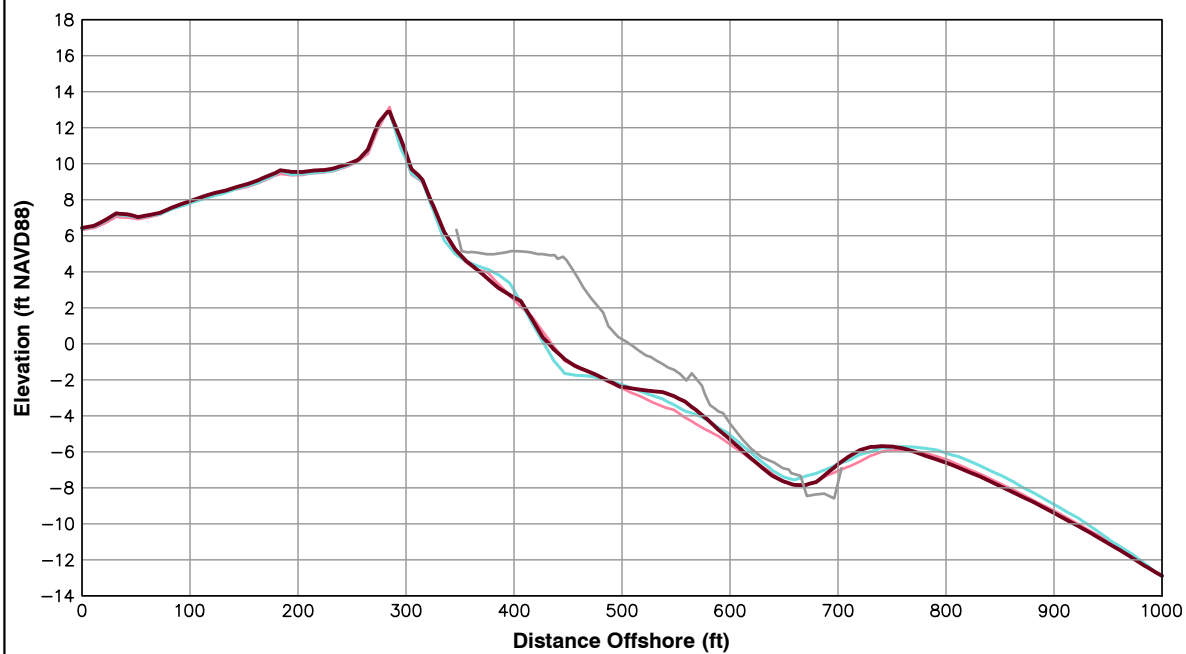
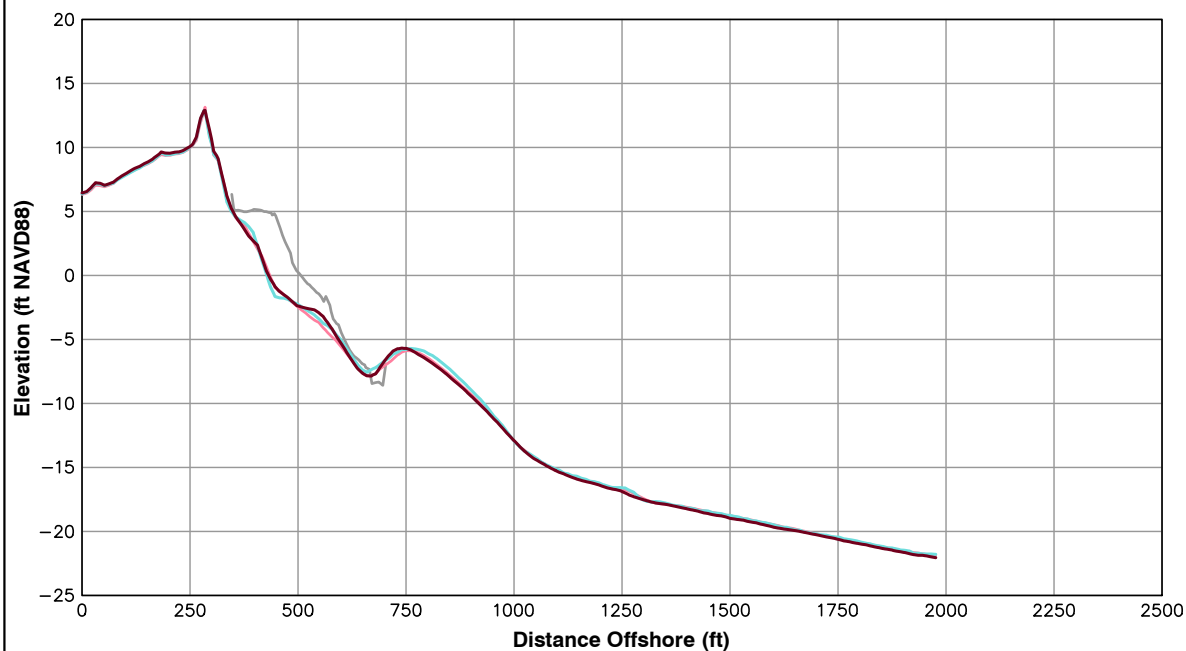
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 344+05

Pg 84 of 106

Fall 2013





Survey Transect 345+85	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-2.42 ft/yr	2.15 ft
Volume Change Above -15 ft NAVD88	3.34 cy/ft/yr	-2.16 cy/ft
Volume Change Above 0 ft NAVD88	1.43 cy/ft/yr	1.04 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

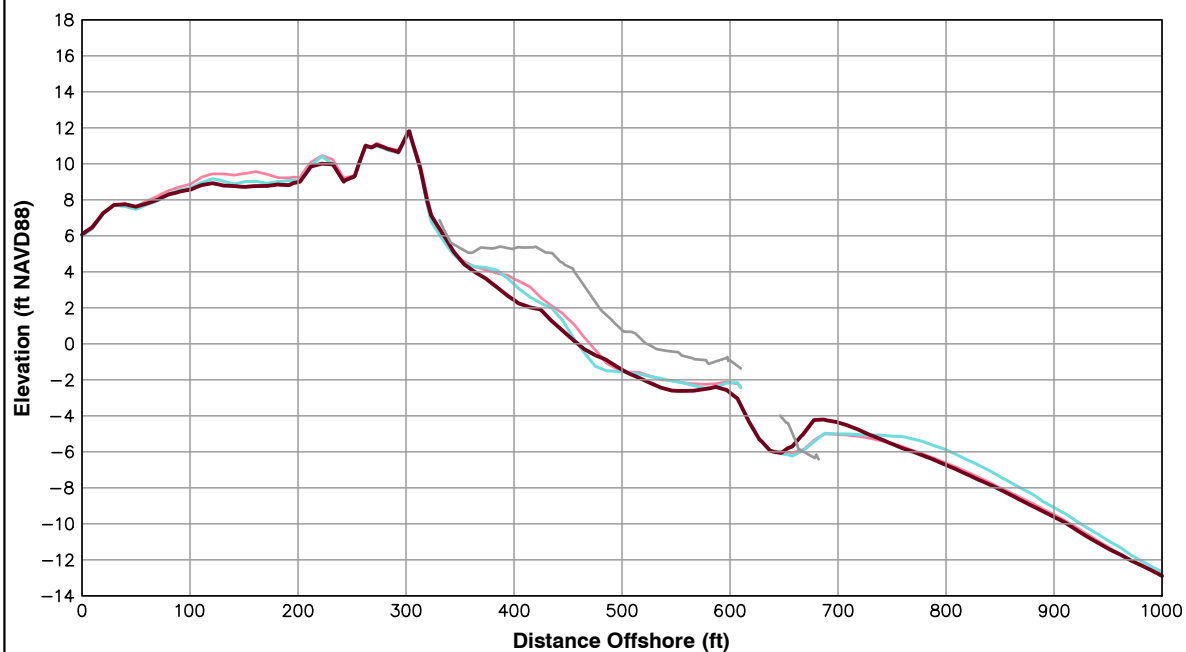
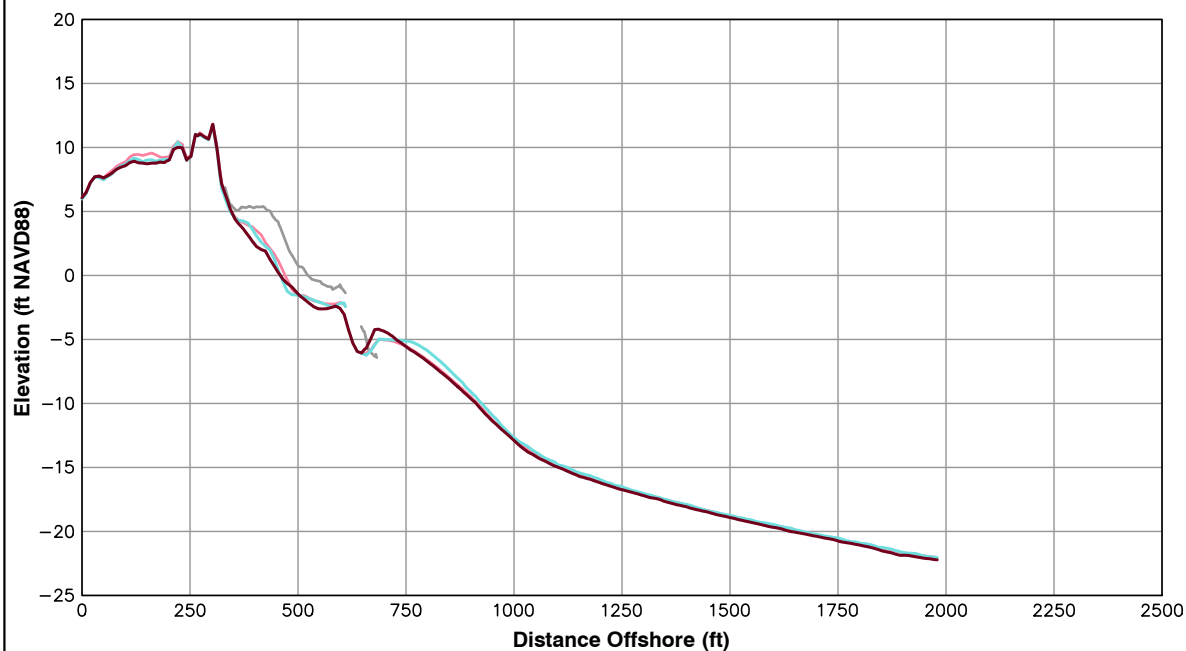


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 345+85**

**Pg 85 of 106**

**Fall 2013**



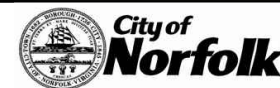
Survey Transect 347+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-15.66 ft/yr	-8.03 ft
Volume Change Above -15 ft NAVD88	-7.05 cy/ft/yr	-8.27 cy/ft
Volume Change Above 0 ft NAVD88	-5.95 cy/ft/yr	-2.53 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

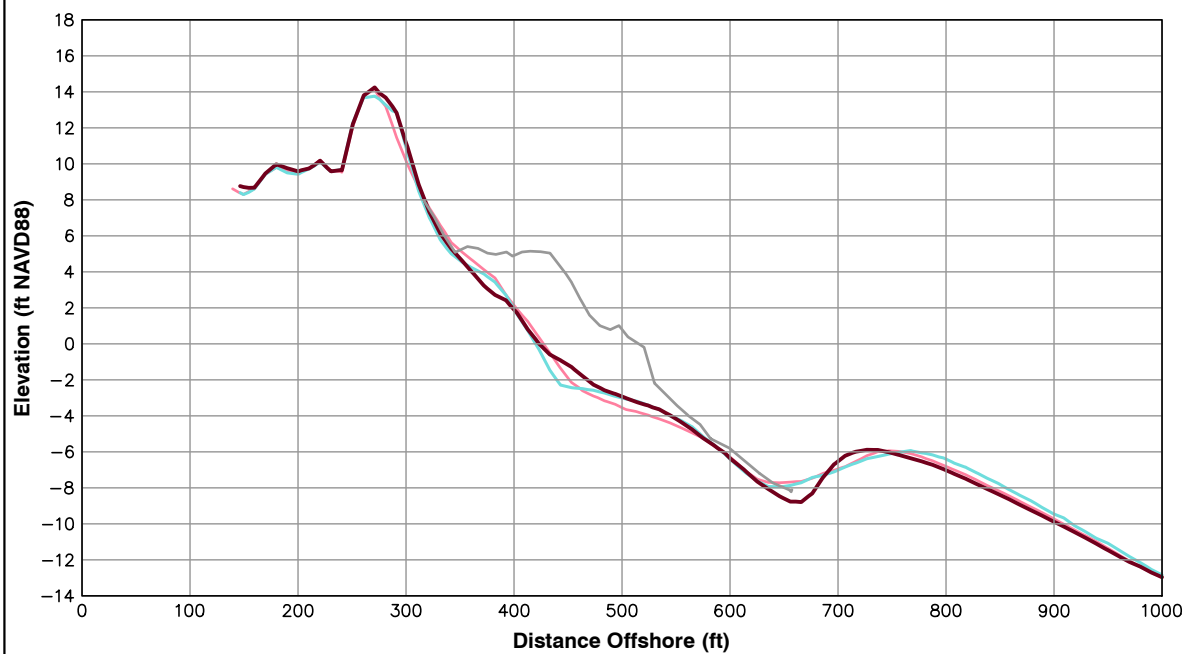
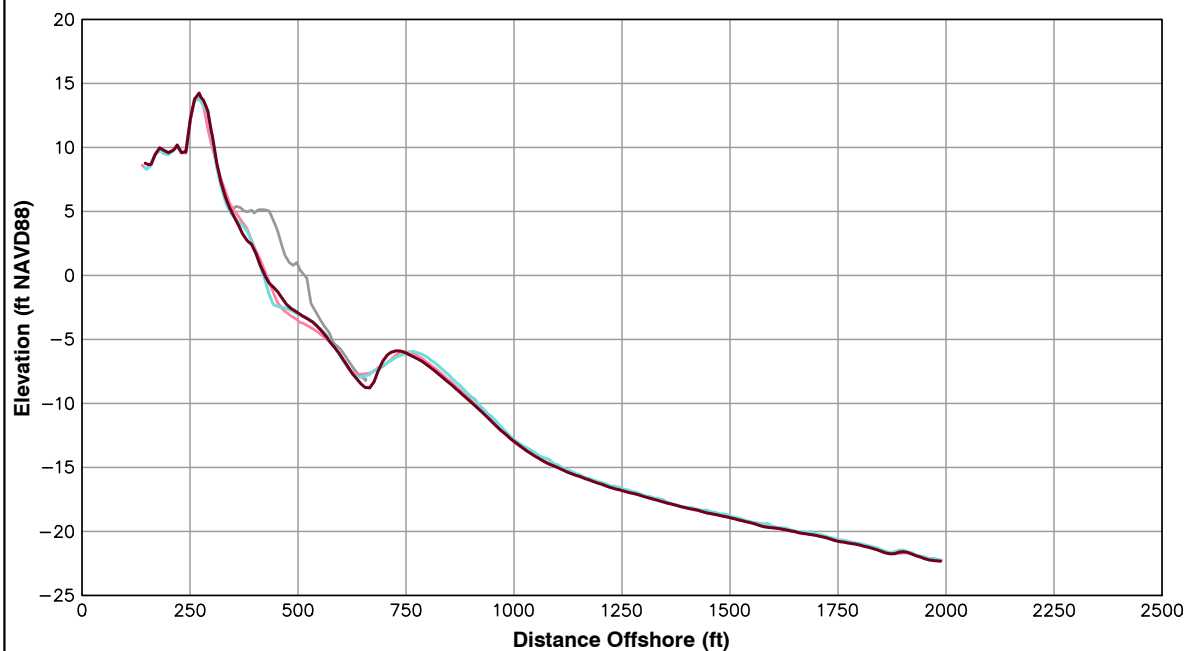


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 347+63

Pg 86 of 106

Fall 2013



Survey Transect 349+43	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-4.74 ft/yr	0.67 ft
Volume Change Above -15 ft NAVD88	-0.38 cy/ft/yr	-2.77 cy/ft
Volume Change Above 0 ft NAVD88	-0.44 cy/ft/yr	0.75 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

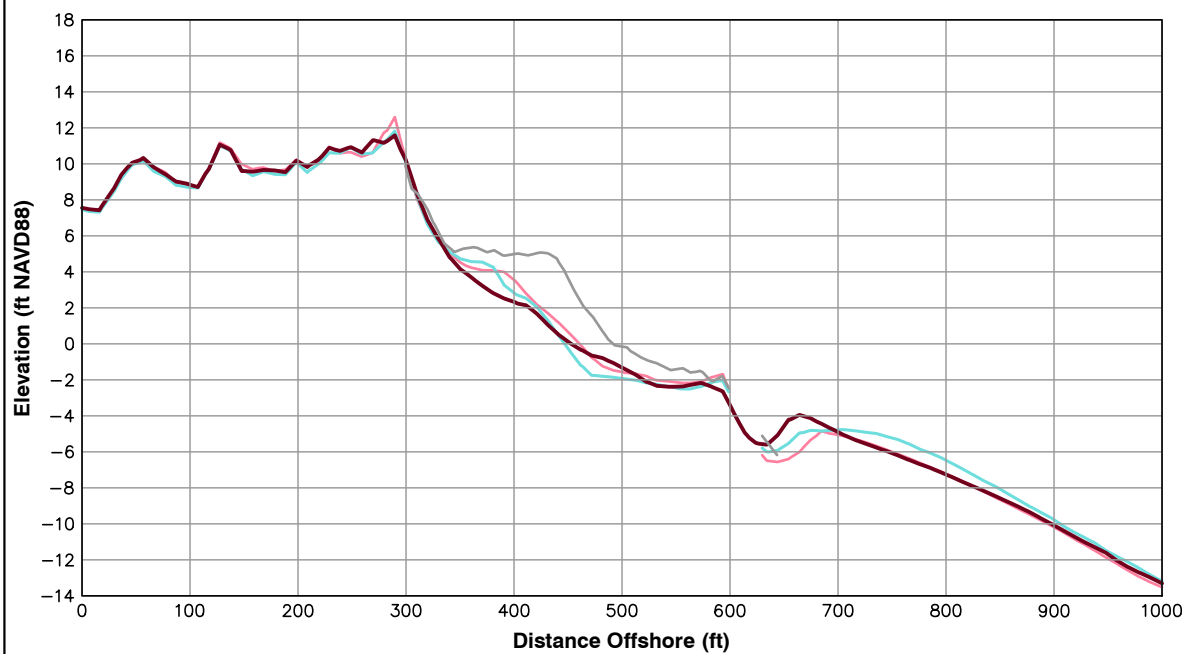
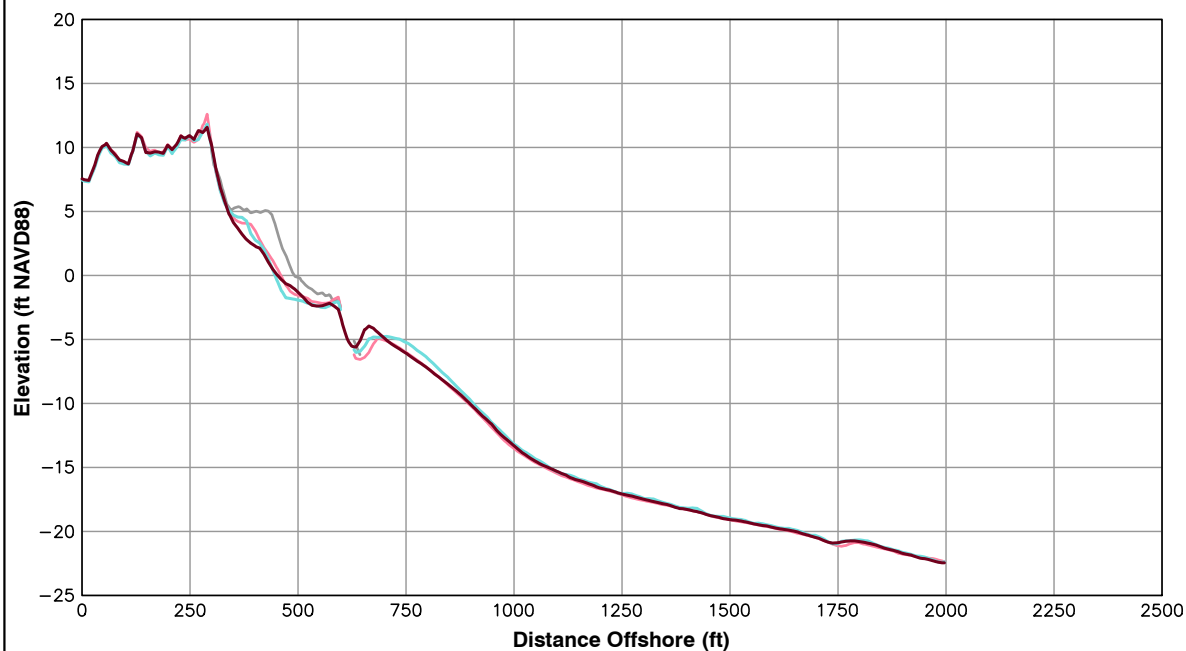
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 349+43**

**Pg 87 of 106**

**Fall 2013**





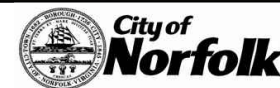
Survey Transect 351+23	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-11.39 ft/yr	-2.48 ft
Volume Change Above -15 ft NAVD88	-0.03 cy/ft/yr	-3.15 cy/ft
Volume Change Above 0 ft NAVD88	-3.32 cy/ft/yr	-0.67 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

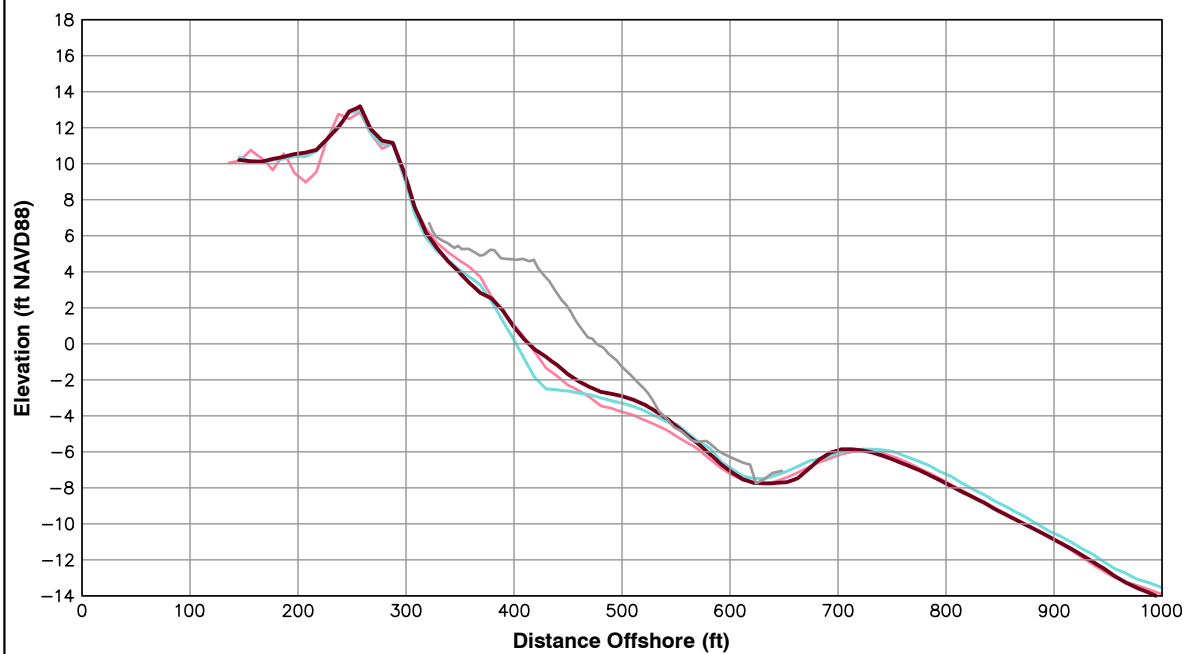
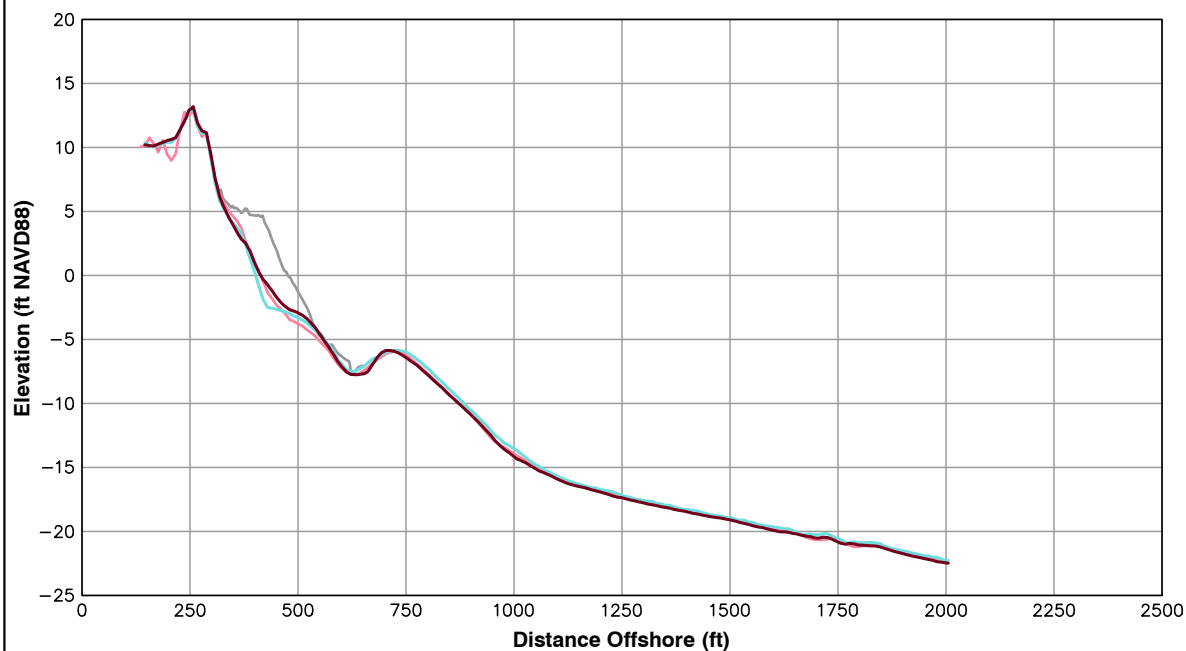


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 351+23

Pg 88 of 106

Fall 2013



Survey Transect 353+03	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.51 ft/yr	6.98 ft
Volume Change Above -15 ft NAVD88	3.41 cy/ft/yr	-1.74 cy/ft
Volume Change Above 0 ft NAVD88	0.34 cy/ft/yr	1.21 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

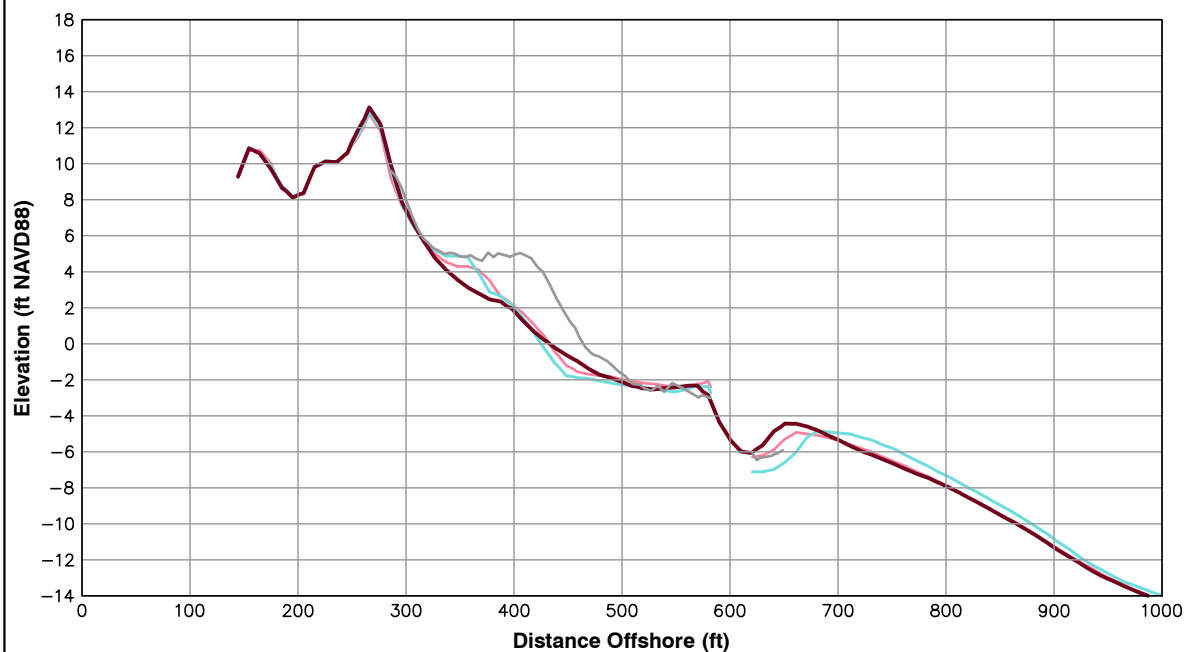
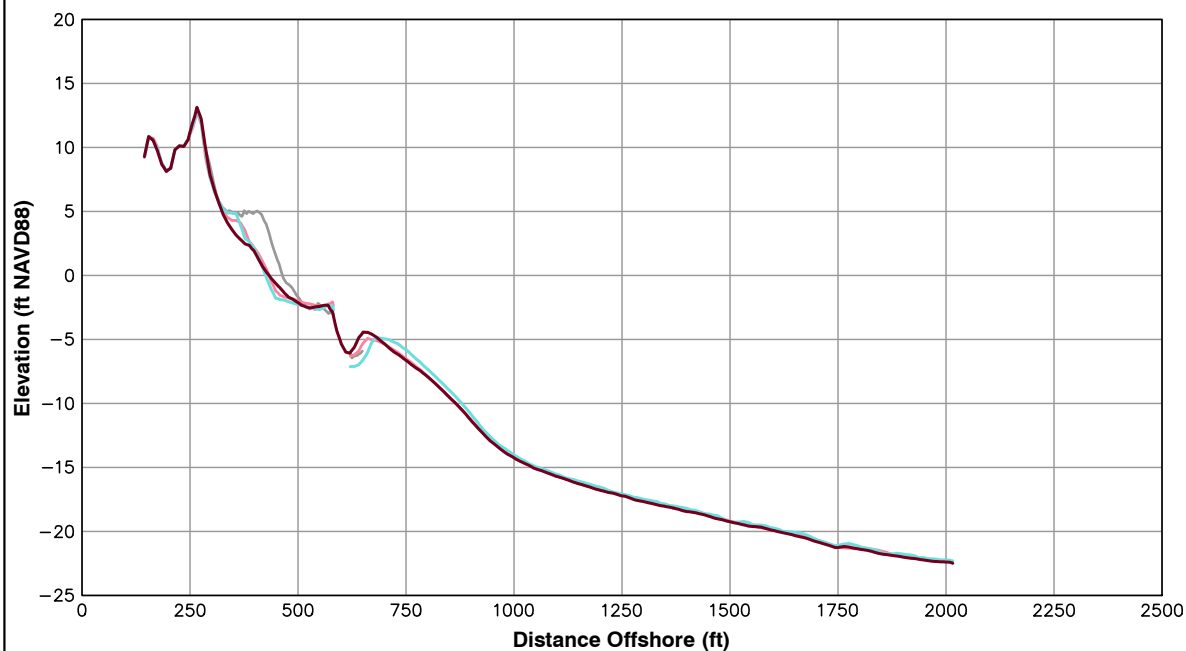


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 353+03**

**Pg 89 of 106**

**Fall 2013**



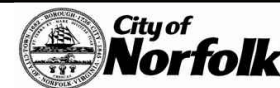
Survey Transect 354+83	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-6.00 ft/yr	-0.46 ft
Volume Change Above -15 ft NAVD88	-0.94 cy/ft/yr	-3.33 cy/ft
Volume Change Above 0 ft NAVD88	-1.59 cy/ft/yr	-1.99 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



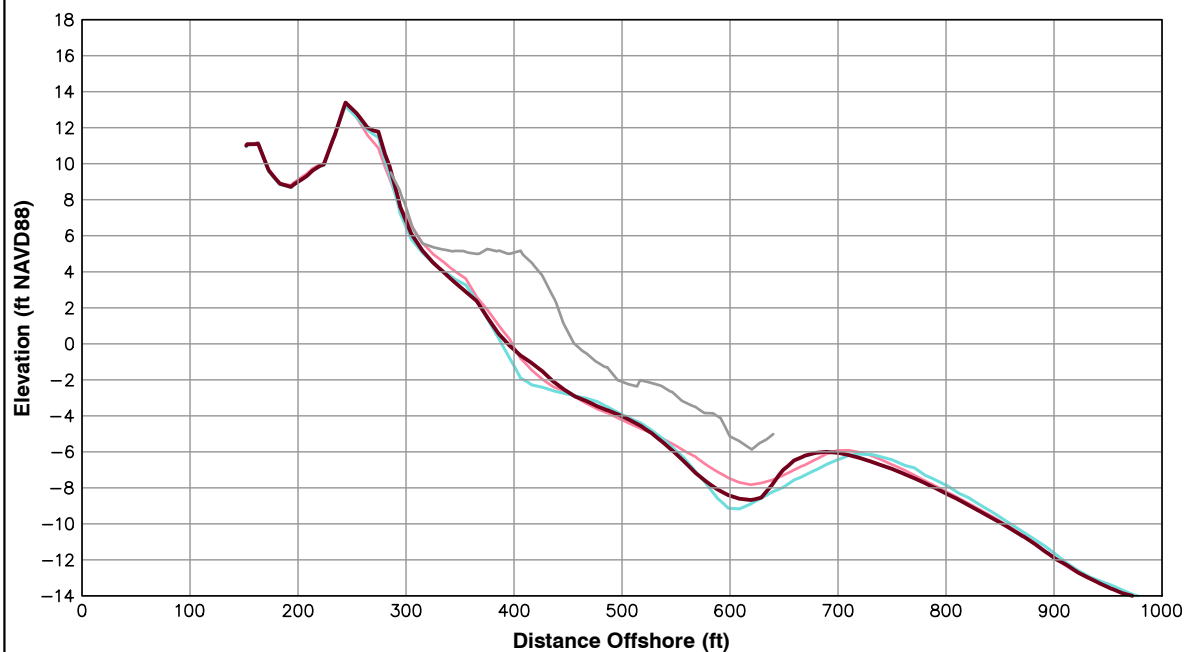
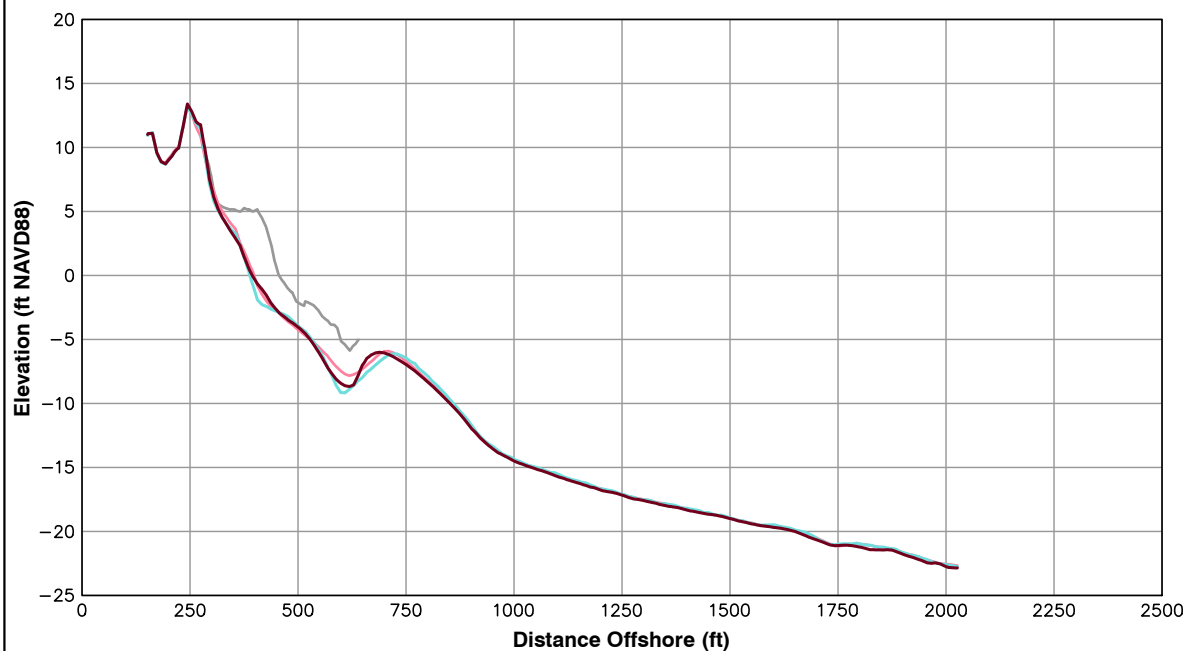
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 354+83

Pg 90 of 106

Fall 2013





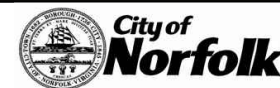
Survey Transect 356+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-5.26 ft/yr	1.56 ft
Volume Change Above -15 ft NAVD88	-3.57 cy/ft/yr	1.43 cy/ft
Volume Change Above 0 ft NAVD88	-0.94 cy/ft/yr	0.73 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

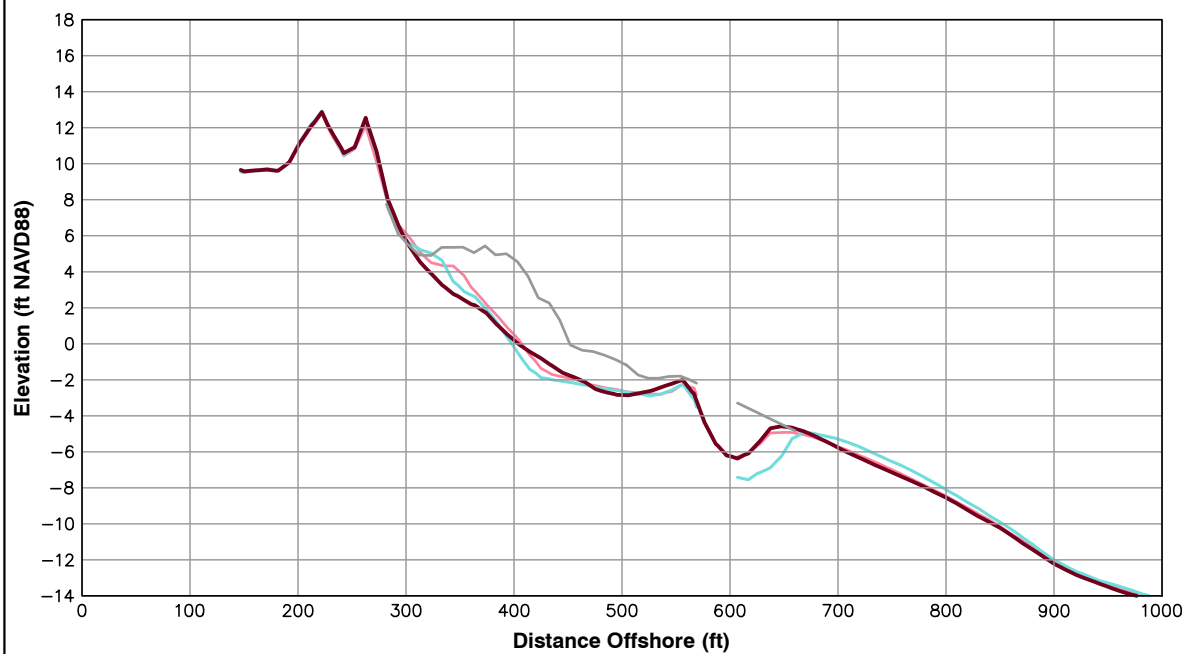
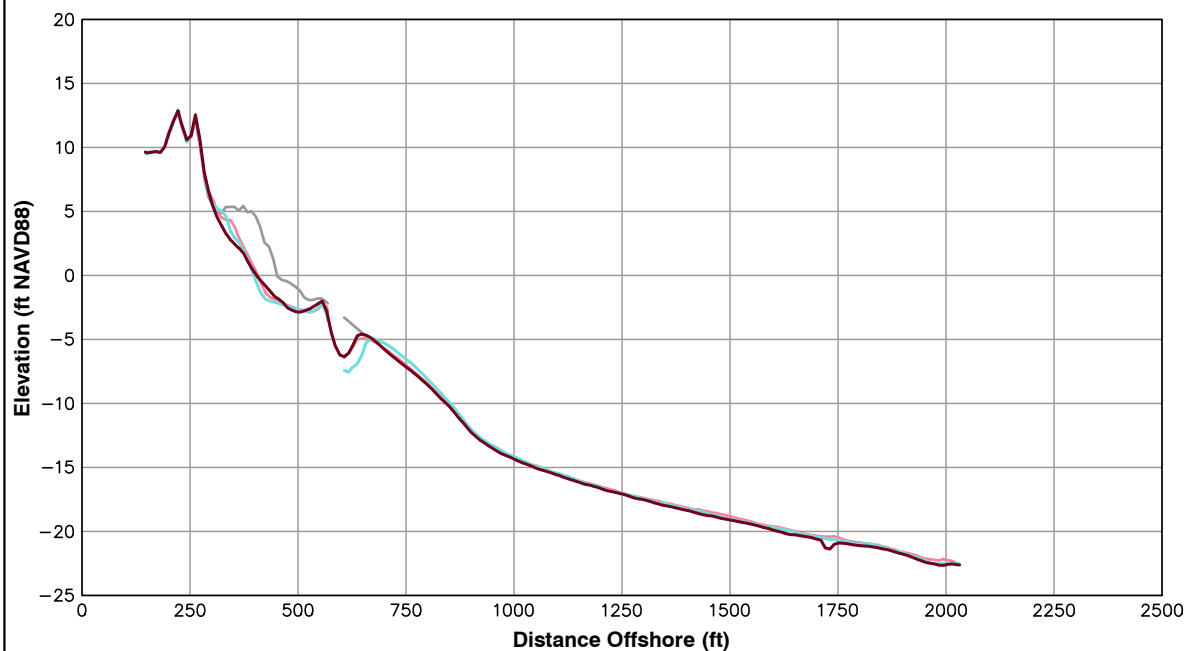


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 356+63**

**Pg 91 of 106**

**Fall 2013**



Survey Transect 358+43	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-6.64 ft/yr	-1.00 ft
Volume Change Above -15 ft NAVD88	-2.78 cy/ft/yr	-1.46 cy/ft
Volume Change Above 0 ft NAVD88	-2.18 cy/ft/yr	-1.72 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

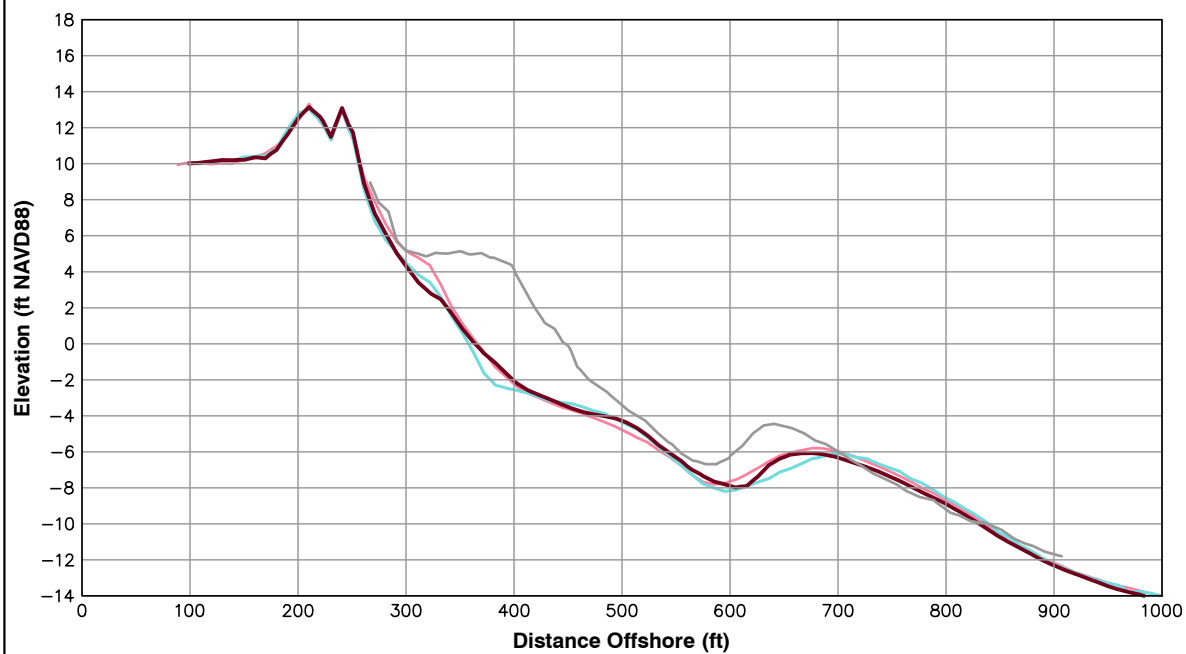
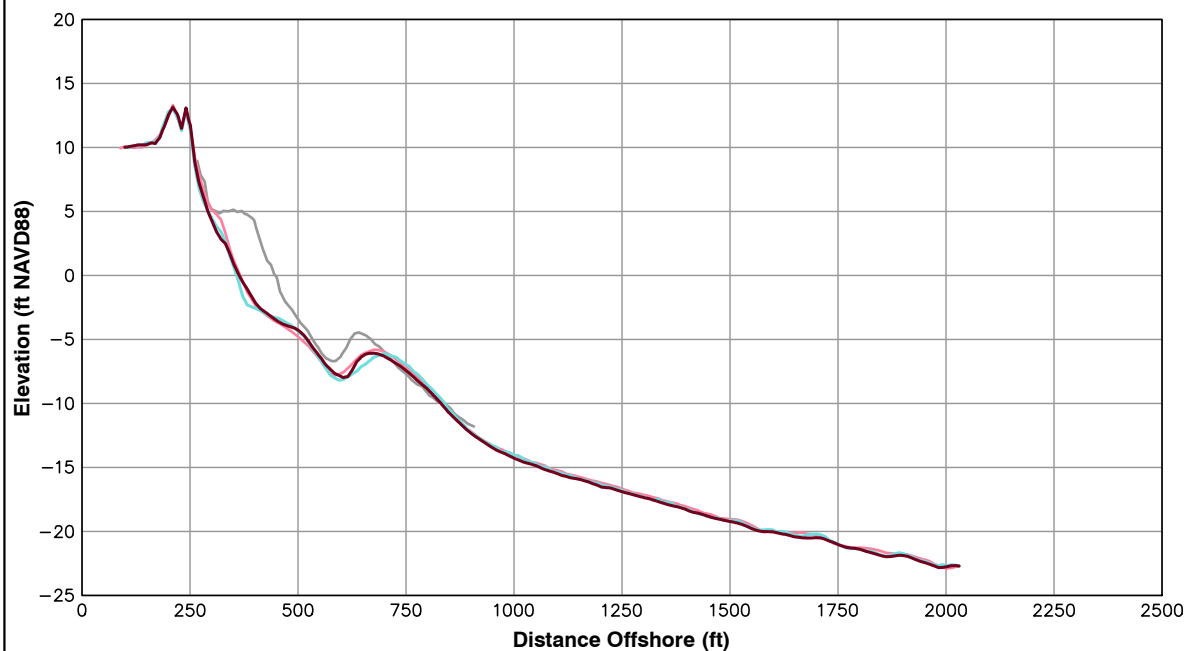


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 358+43

Pg 92 of 106

Fall 2013



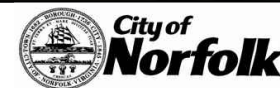
Survey Transect 360+23	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-3.14 ft/yr	2.42 ft
Volume Change Above -15 ft NAVD88	-4.31 cy/ft/yr	0.11 cy/ft
Volume Change Above 0 ft NAVD88	-2.40 cy/ft/yr	0.16 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



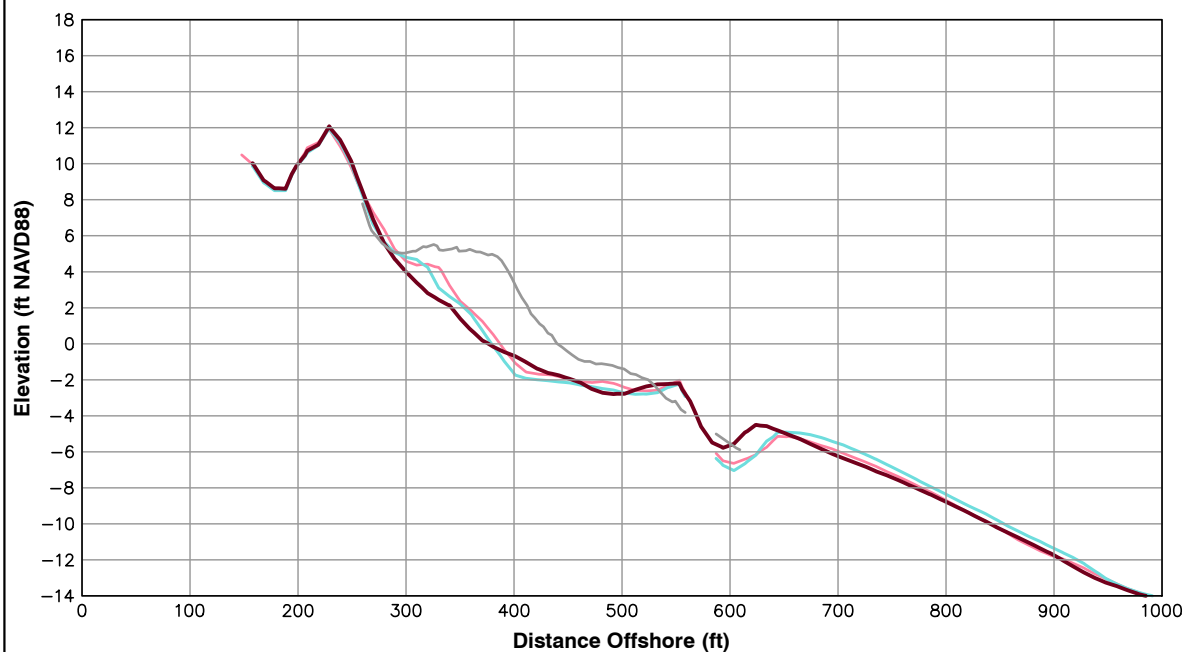
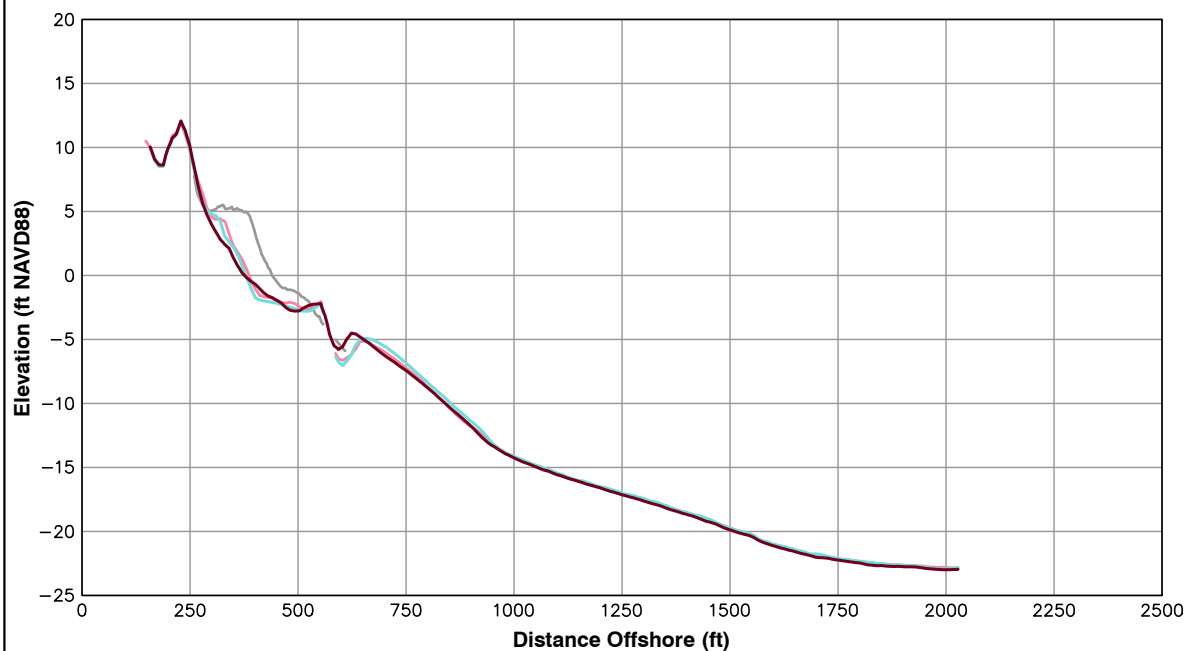
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 360+23**

**Pg 93 of 106**

**Fall 2013**





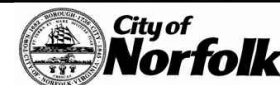
Survey Transect 362+03	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-16.67 ft/yr	-11.23 ft
Volume Change Above -15 ft NAVD88	-2.86 cy/ft/yr	-3.43 cy/ft
Volume Change Above 0 ft NAVD88	-3.78 cy/ft/yr	-2.16 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

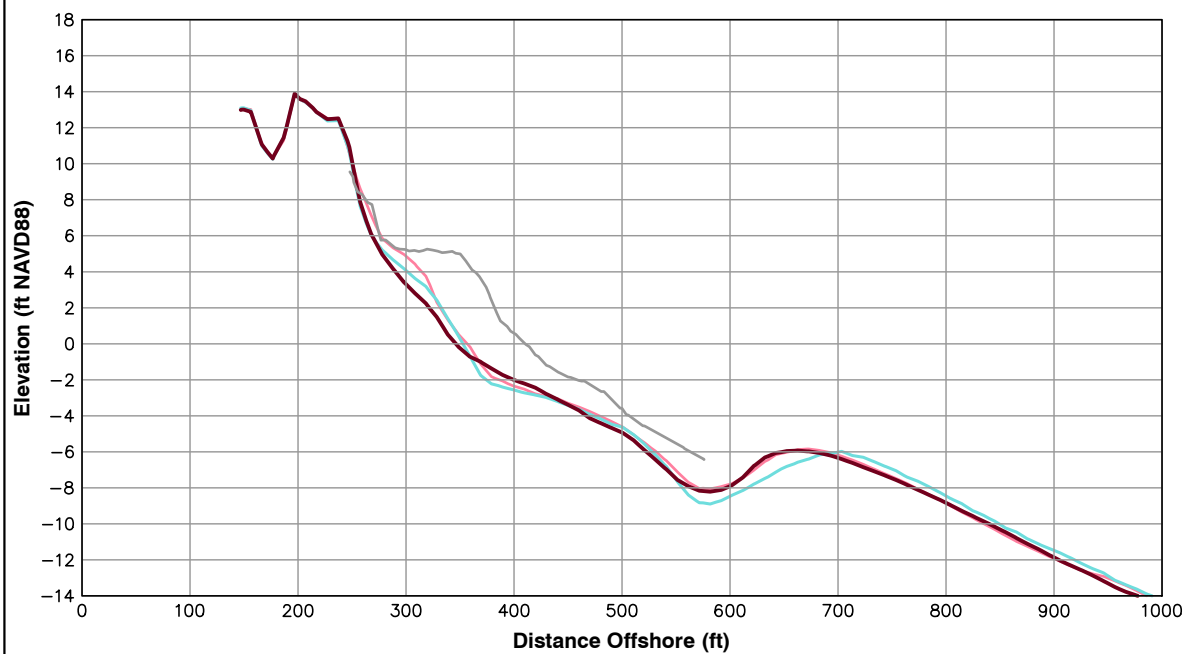
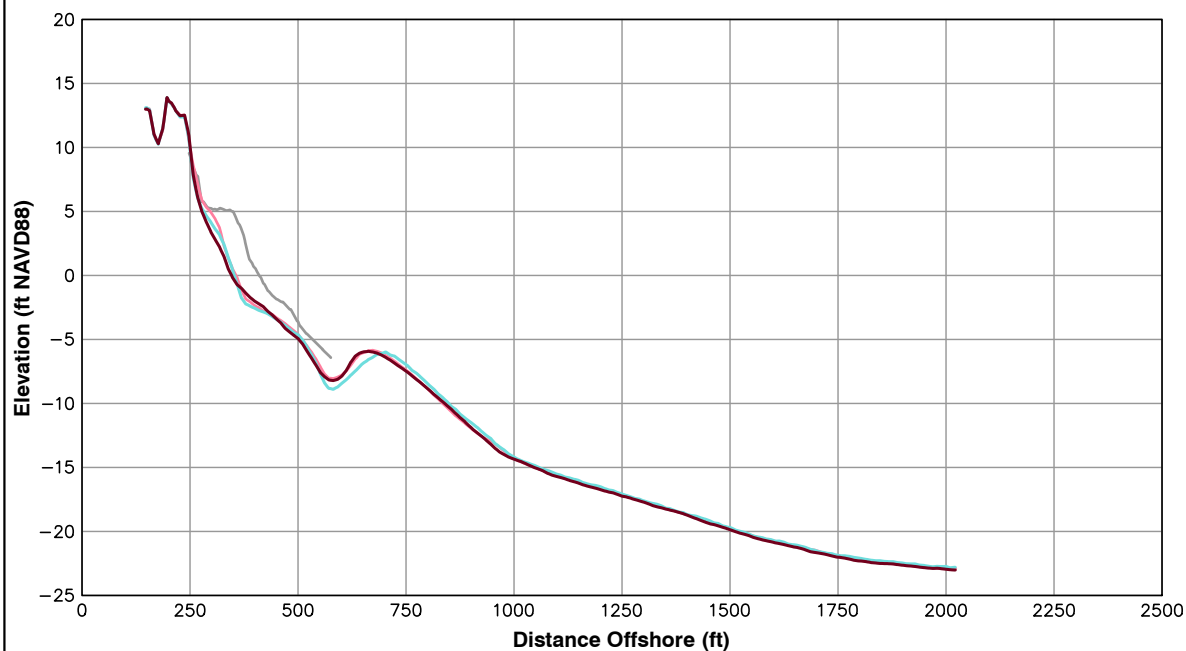


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 362+03

Pg 94 of 106

Fall 2013



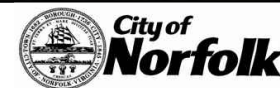
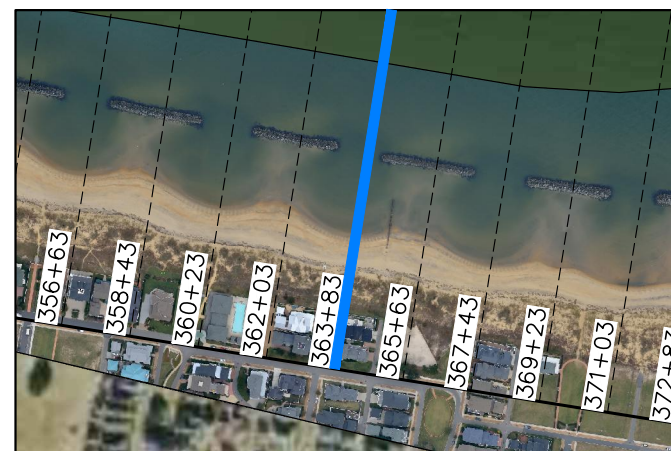
Survey Transect 363+83	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-8.66 ft/yr	-9.14 ft
Volume Change Above -15 ft NAVD88	-5.21 cy/ft/yr	-2.27 cy/ft
Volume Change Above 0 ft NAVD88	-3.69 cy/ft/yr	-1.72 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

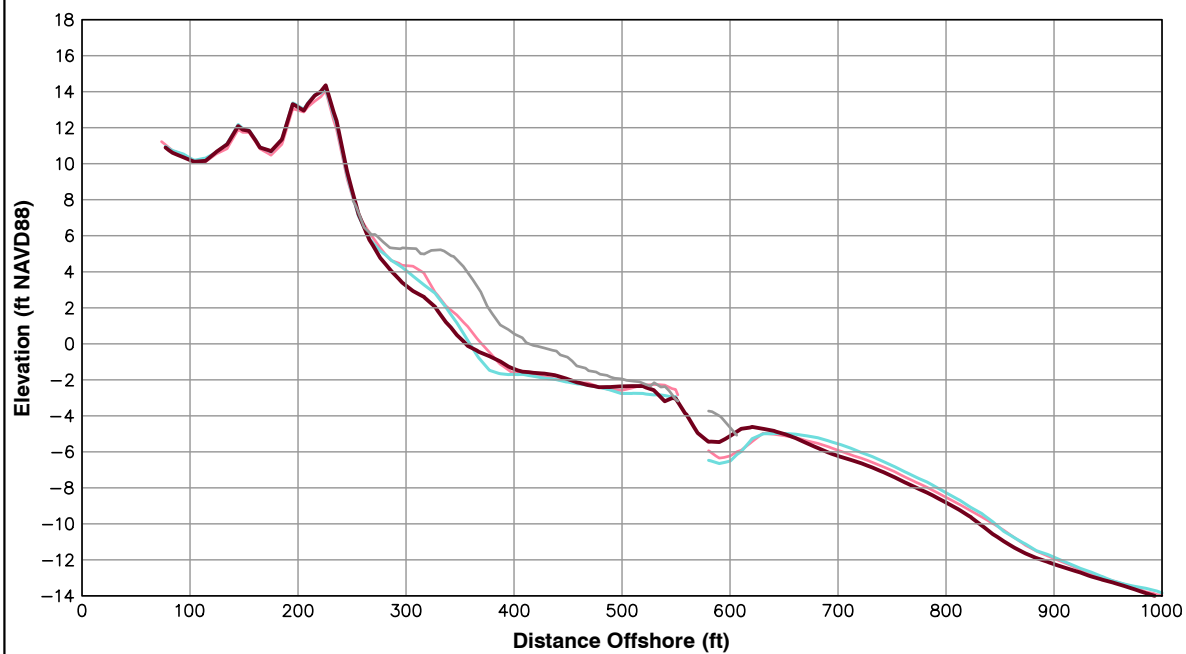
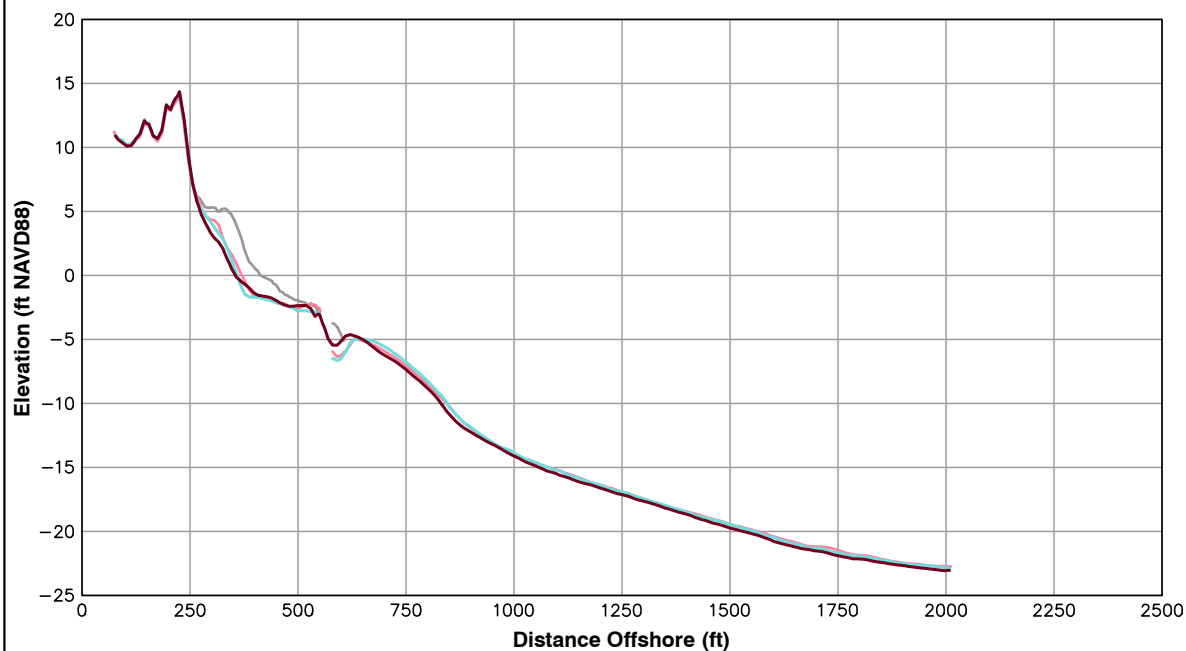


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 363+83**

**Pg 95 of 106**

**Fall 2013**



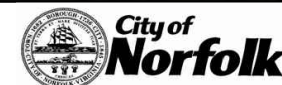
Survey Transect 365+63	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-15.41 ft/yr	-8.45 ft
Volume Change Above -15 ft NAVD88	-4.65 cy/ft/yr	-5.02 cy/ft
Volume Change Above 0 ft NAVD88	-2.21 cy/ft/yr	-2.23 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



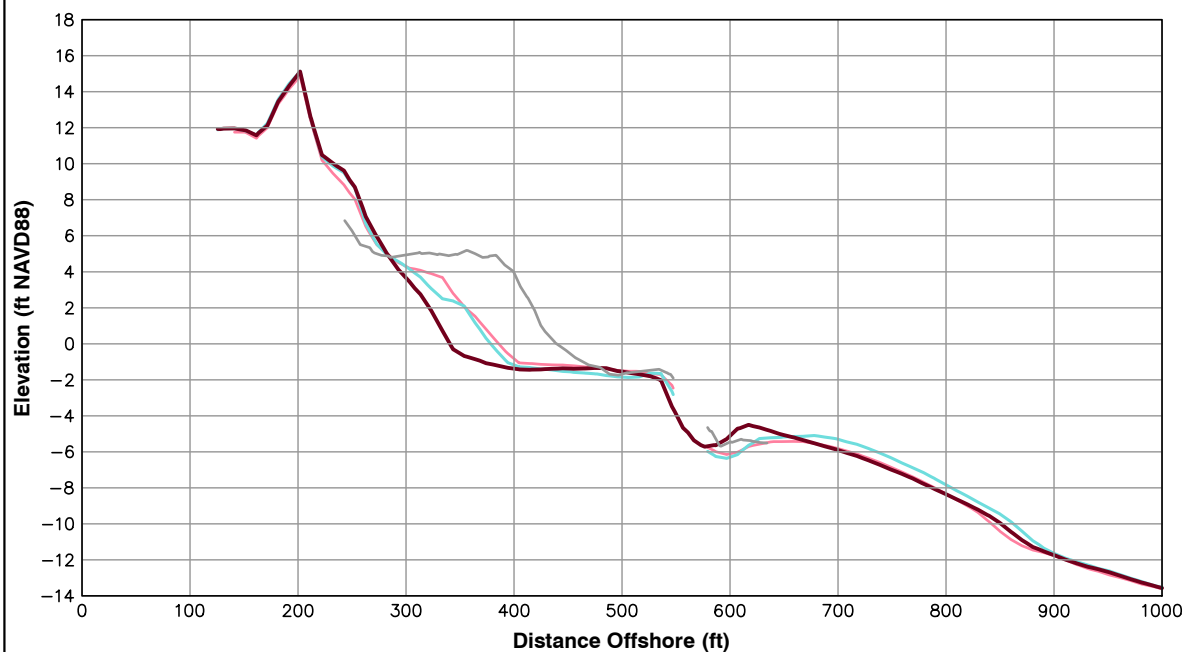
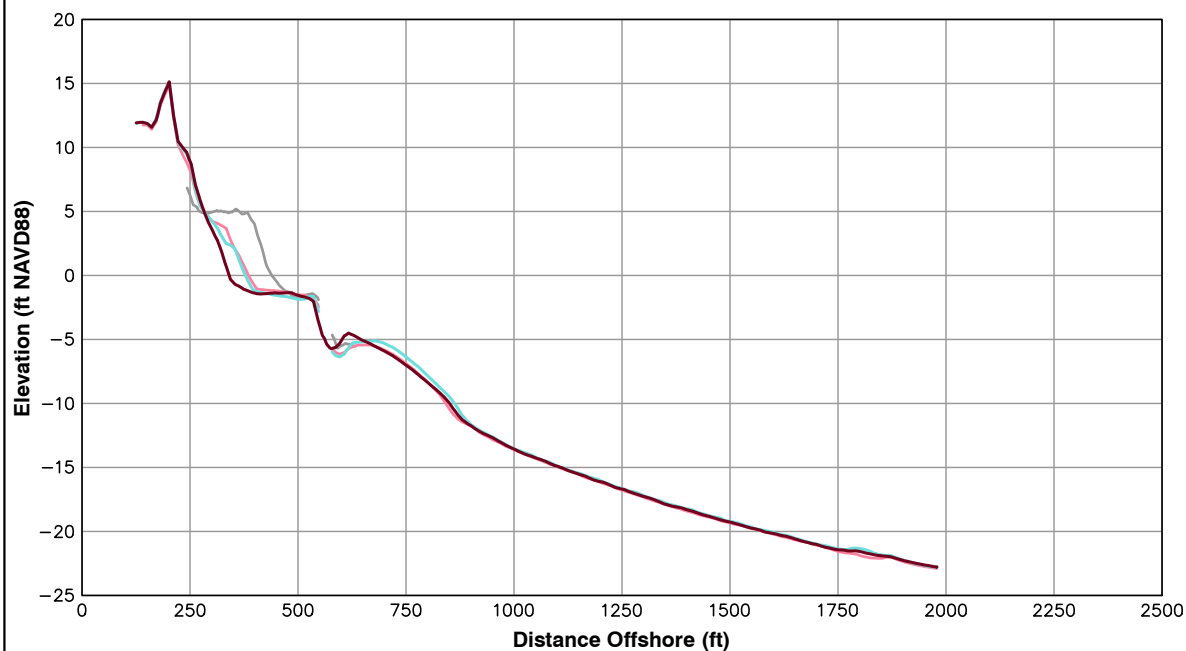
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 365+63

Pg 96 of 106

Fall 2013





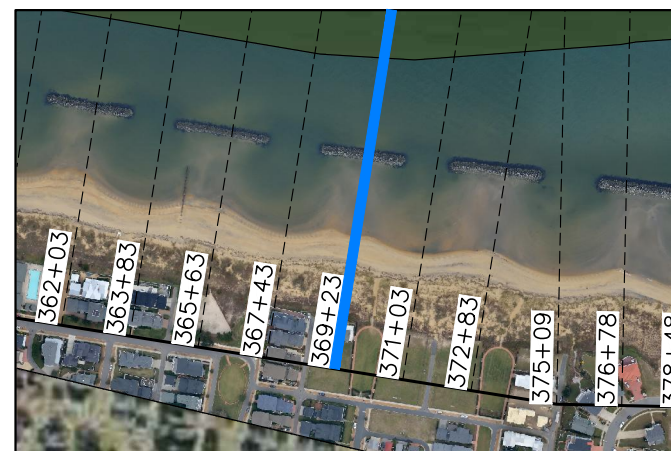
Survey Transect 369+23	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-38.16 ft/yr	-34.86 ft
Volume Change Above -15 ft NAVD88	-3.55 cy/ft/yr	-7.83 cy/ft
Volume Change Above 0 ft NAVD88	-3.67 cy/ft/yr	-3.79 cy/ft

**LEGEND:**



**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

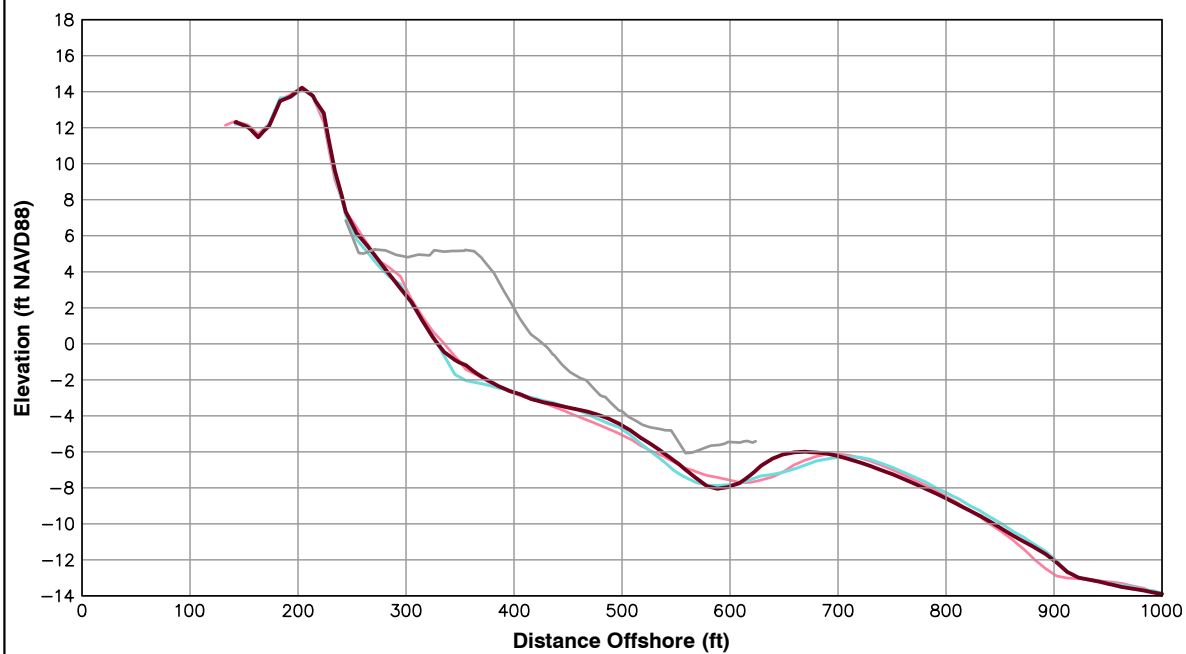
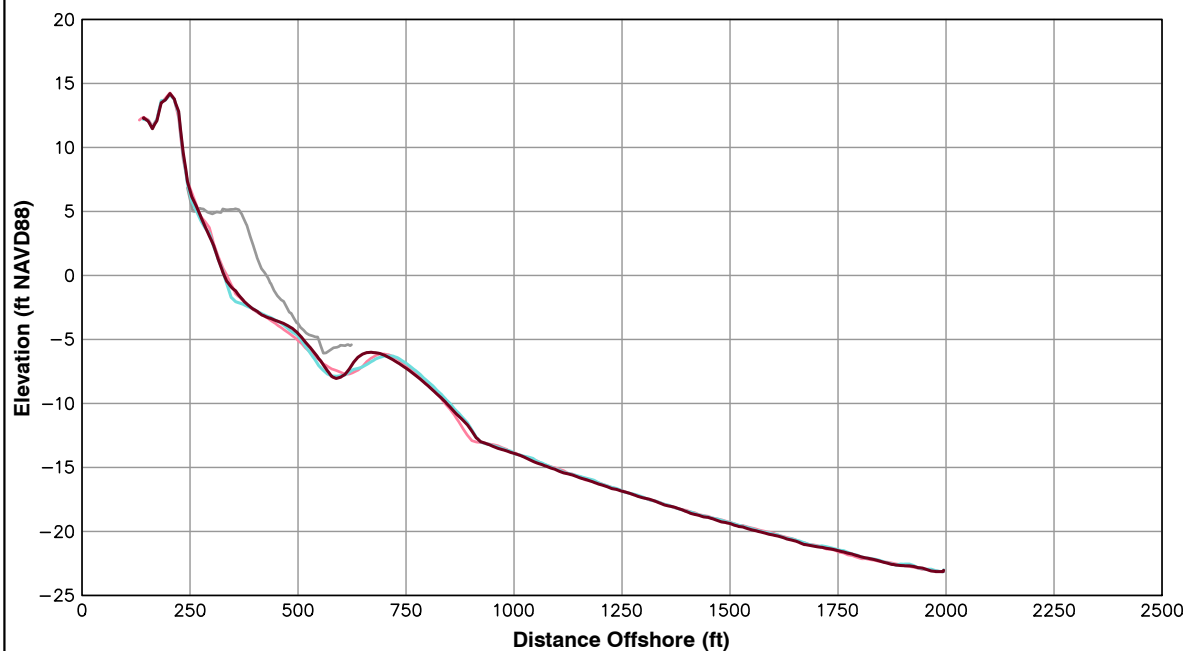


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 369+23

Pg 97 of 106

Fall 2013



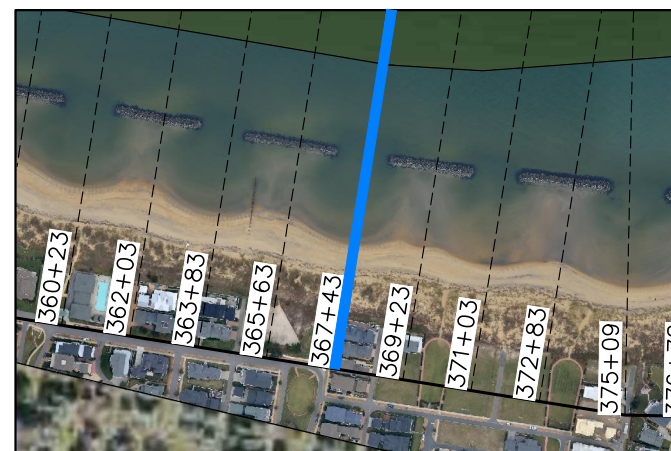
Survey Transect 367+43	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-2.87 ft/yr	-0.25 ft
Volume Change Above -15 ft NAVD88	1.76 cy/ft/yr	2.04 cy/ft
Volume Change Above 0 ft NAVD88	-0.67 cy/ft/yr	0.54 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

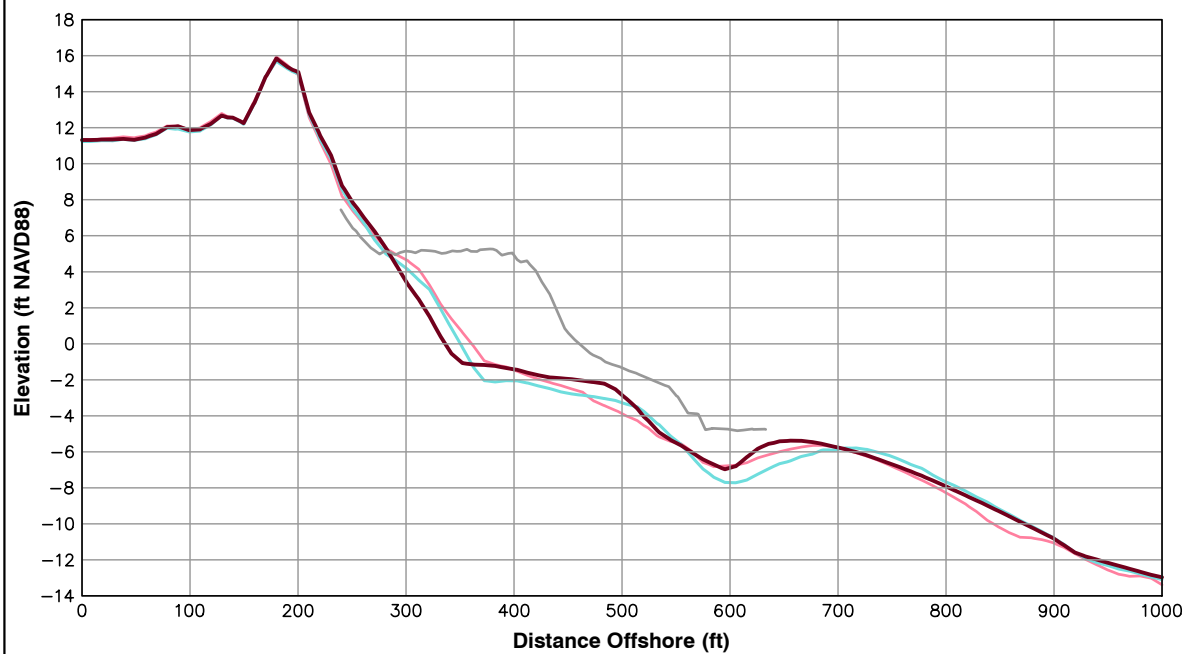
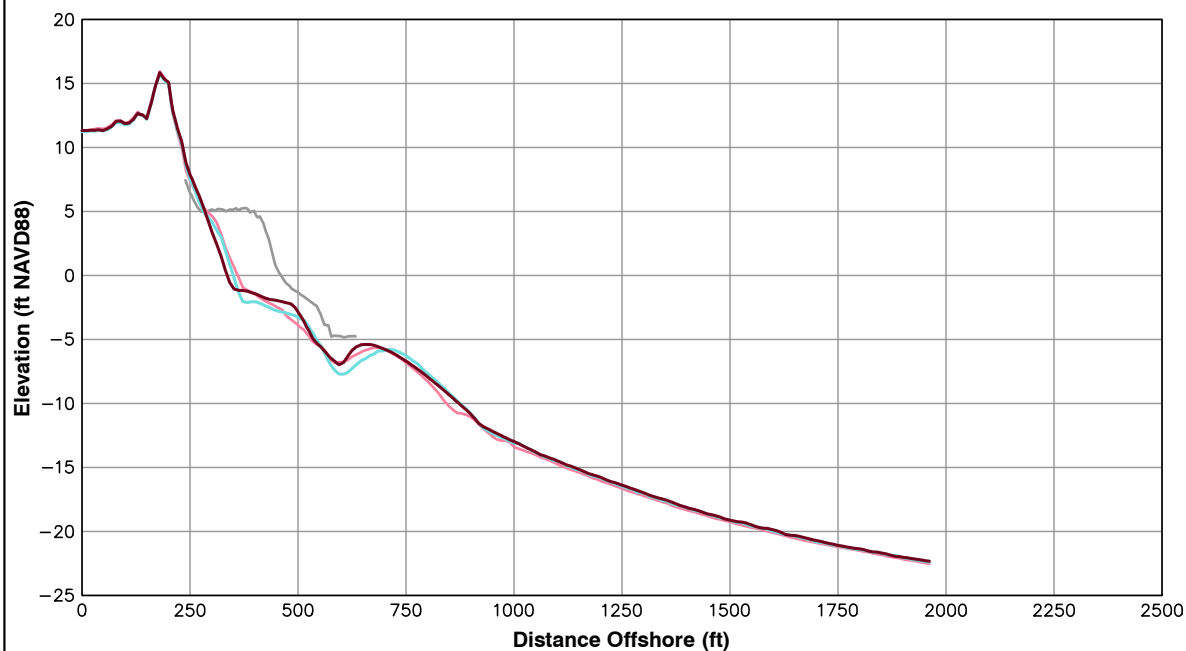


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 367+43

Pg 98 of 106

Fall 2013



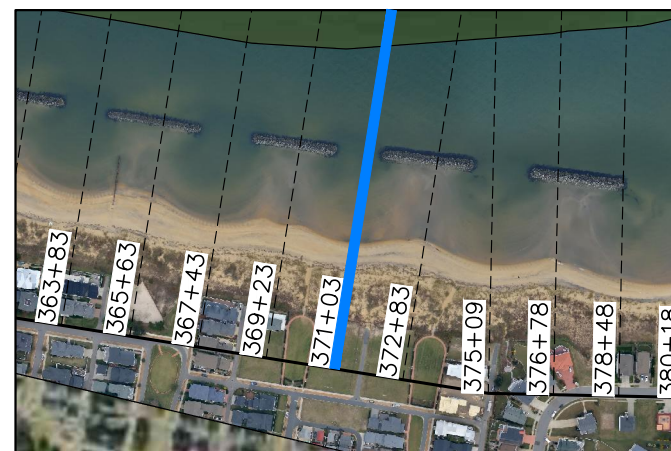
Survey Transect 371+03	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-19.77 ft/yr	-14.27 ft
Volume Change Above -15 ft NAVD88	5.03 cy/ft/yr	4.96 cy/ft
Volume Change Above 0 ft NAVD88	-2.68 cy/ft/yr	-0.96 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



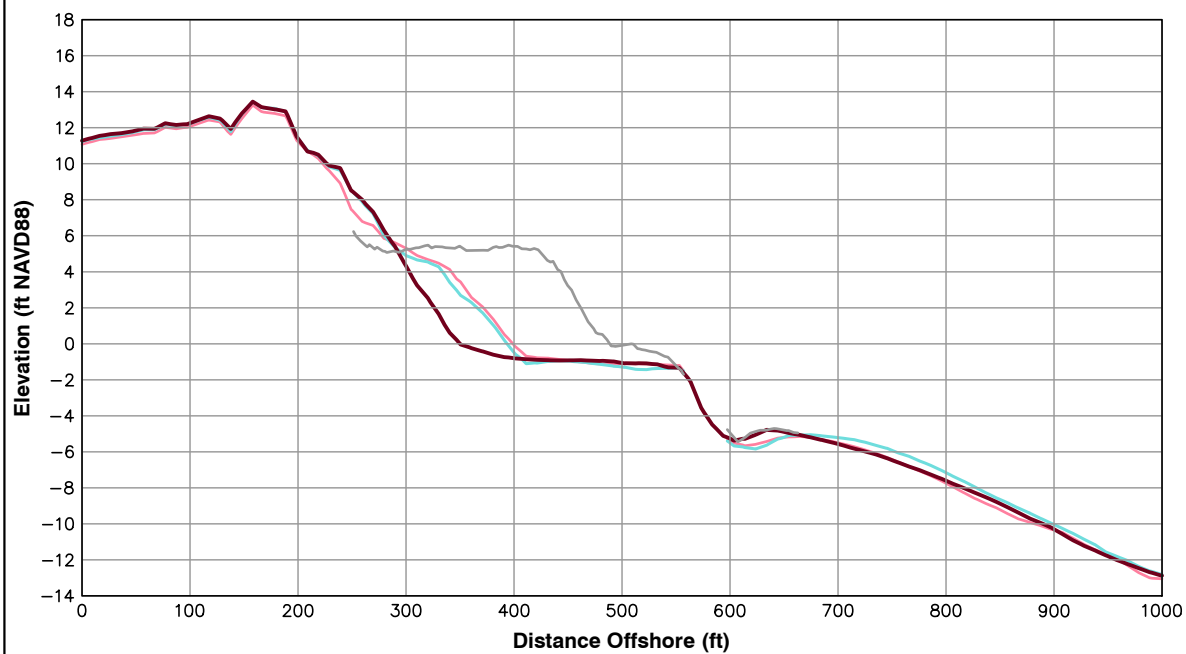
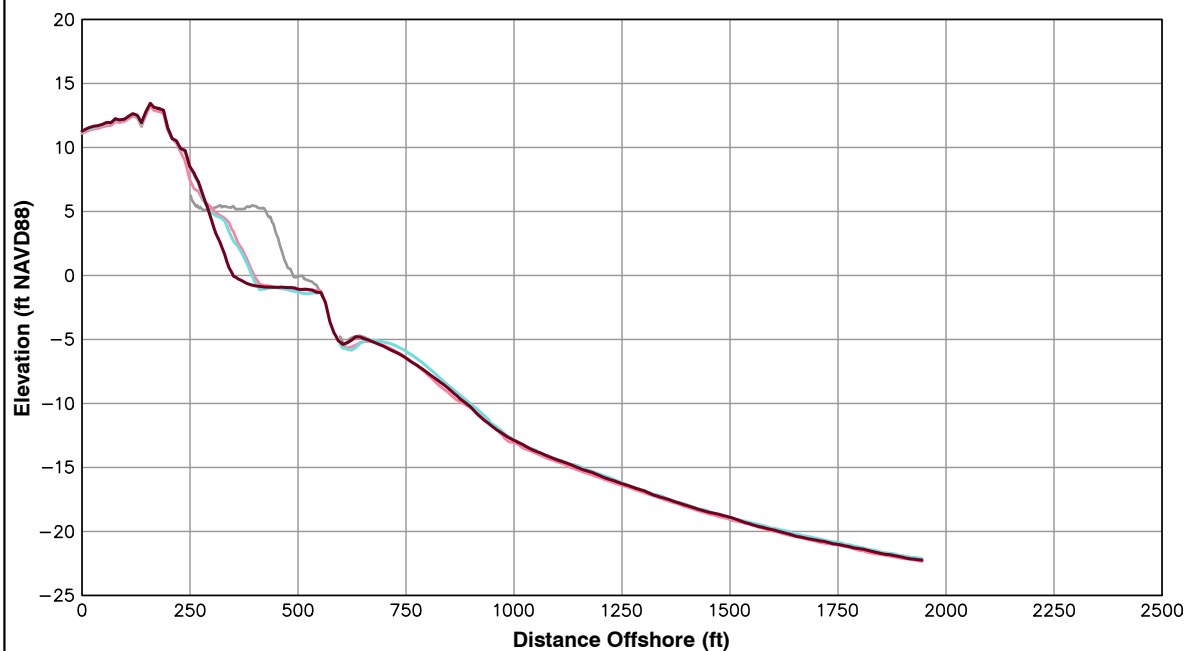
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 371+03

Pg 99 of 106

Fall 2013





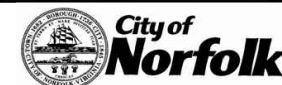
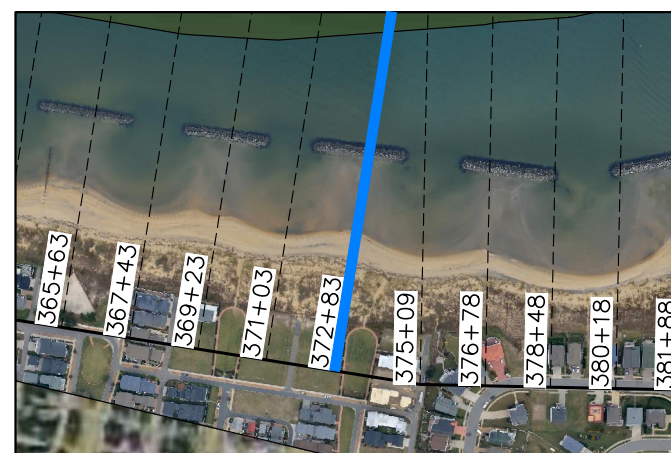
Survey Transect 372+83	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-46.31 ft/yr	-44.97 ft
Volume Change Above -15 ft NAVD88	-2.51 cy/ft/yr	-8.89 cy/ft
Volume Change Above 0 ft NAVD88	-4.21 cy/ft/yr	-5.83 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

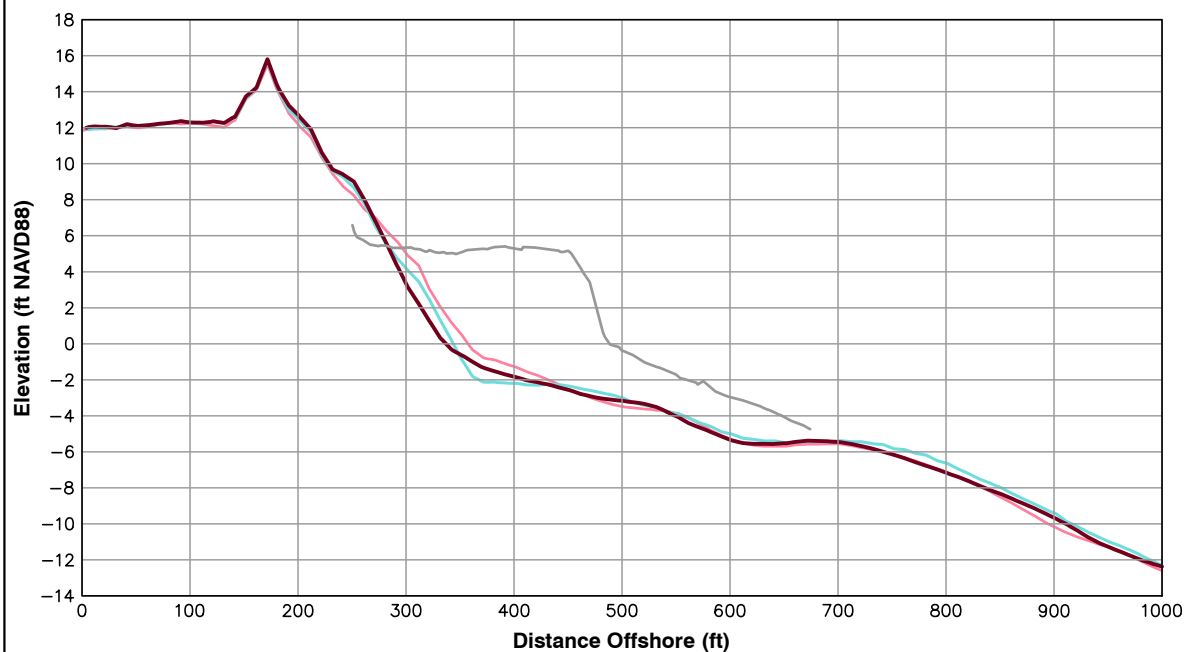
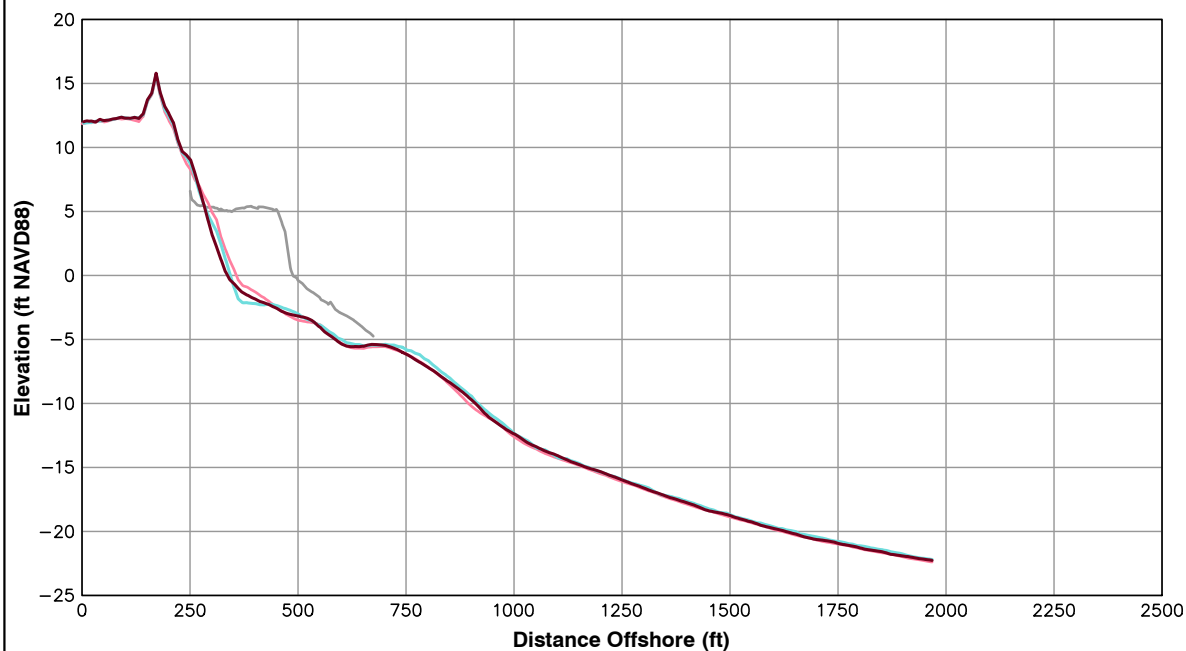


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 372+83

Pg 100 of 106

Fall 2013



Survey Transect 375+08	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-18.99 ft/yr	-10.10 ft
Volume Change Above -15 ft NAVD88	-0.66 cy/ft/yr	-4.82 cy/ft
Volume Change Above 0 ft NAVD88	-1.76 cy/ft/yr	-0.86 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

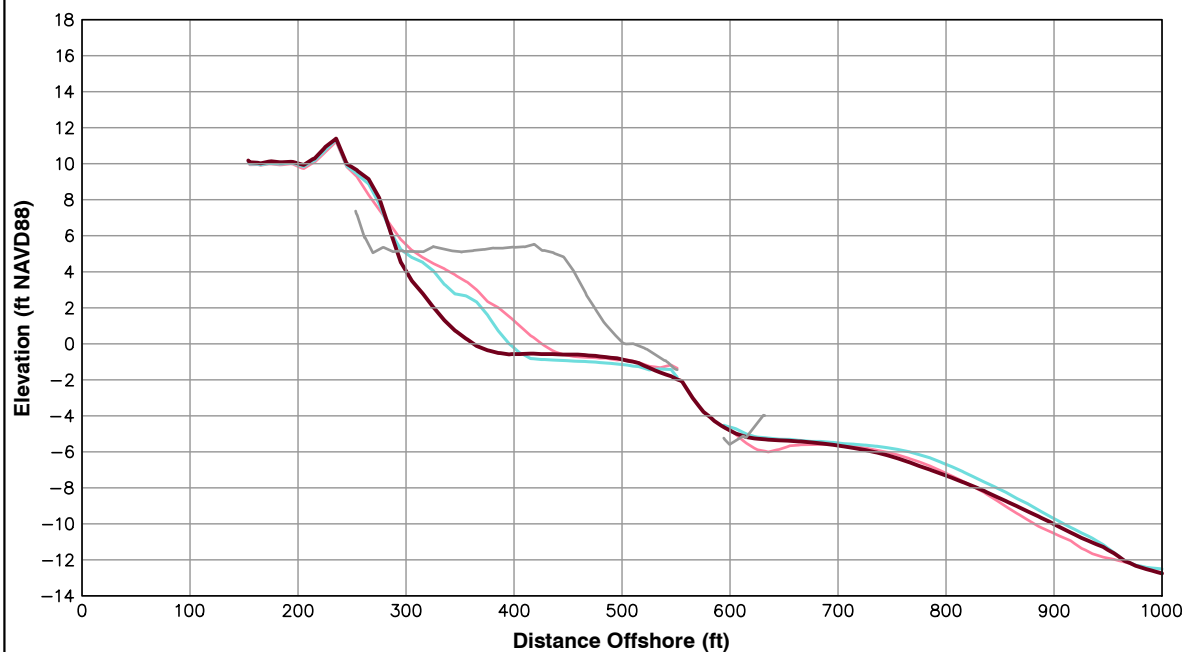
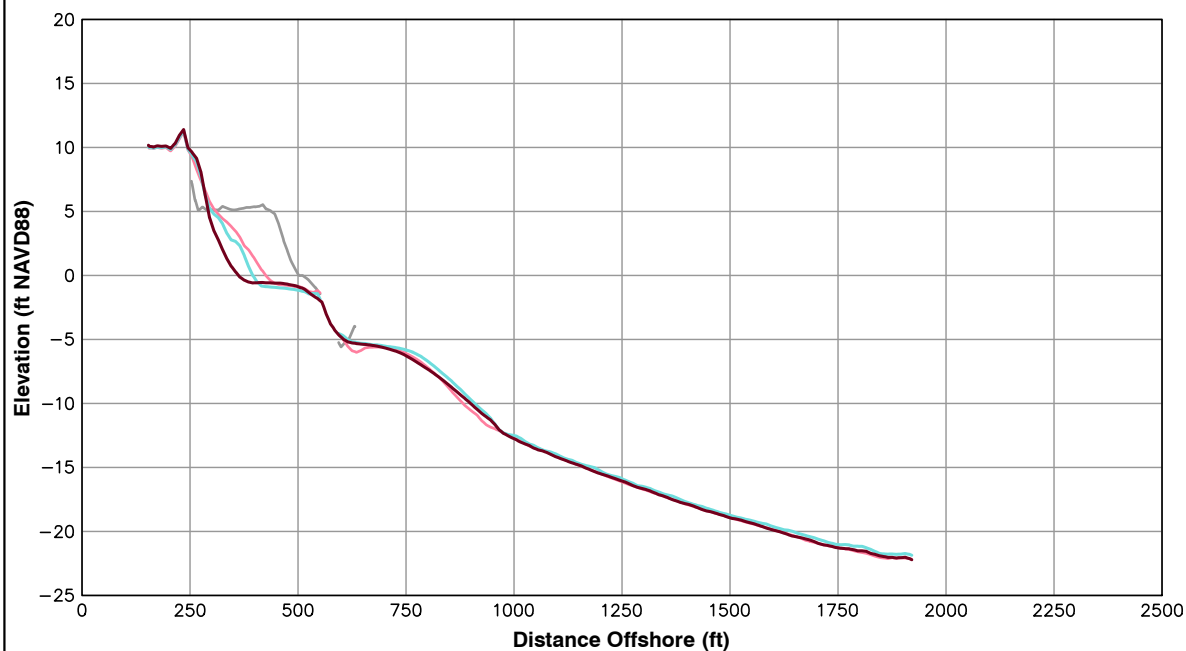


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 375+08

Pg 101 of 106

Fall 2013



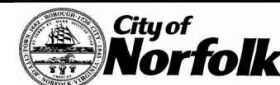
Survey Transect 376+78	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-61.01 ft/yr	-41.36 ft
Volume Change Above -15 ft NAVD88	-7.60 cy/ft/yr	-10.62 cy/ft
Volume Change Above 0 ft NAVD88	-8.32 cy/ft/yr	-5.59 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



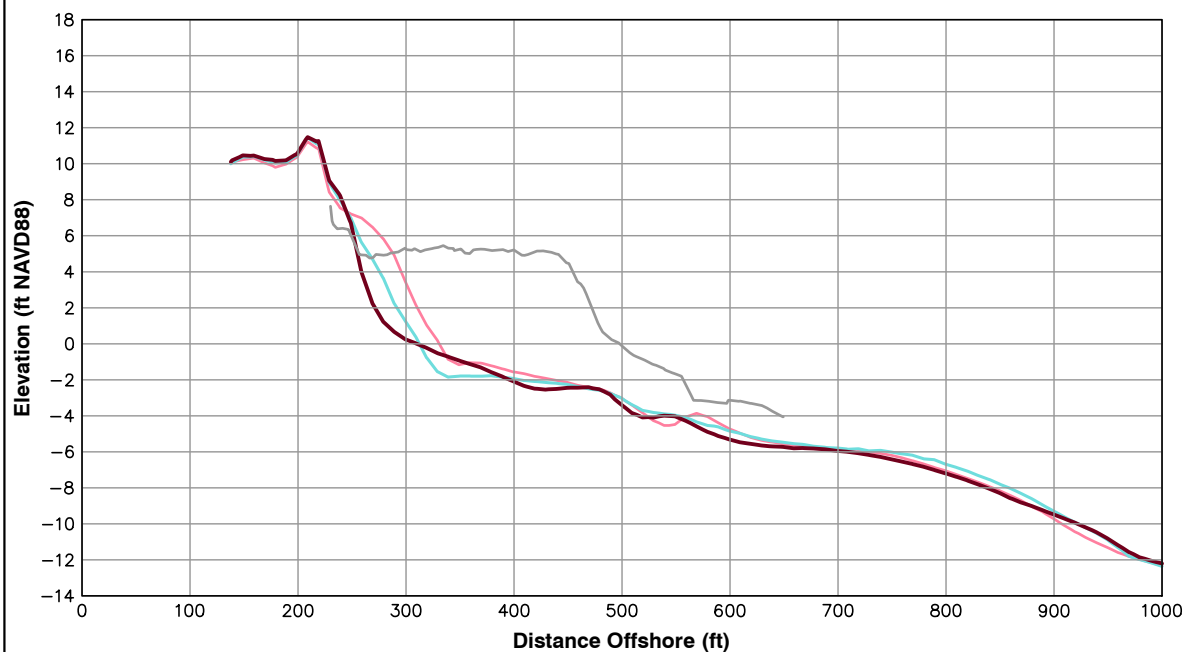
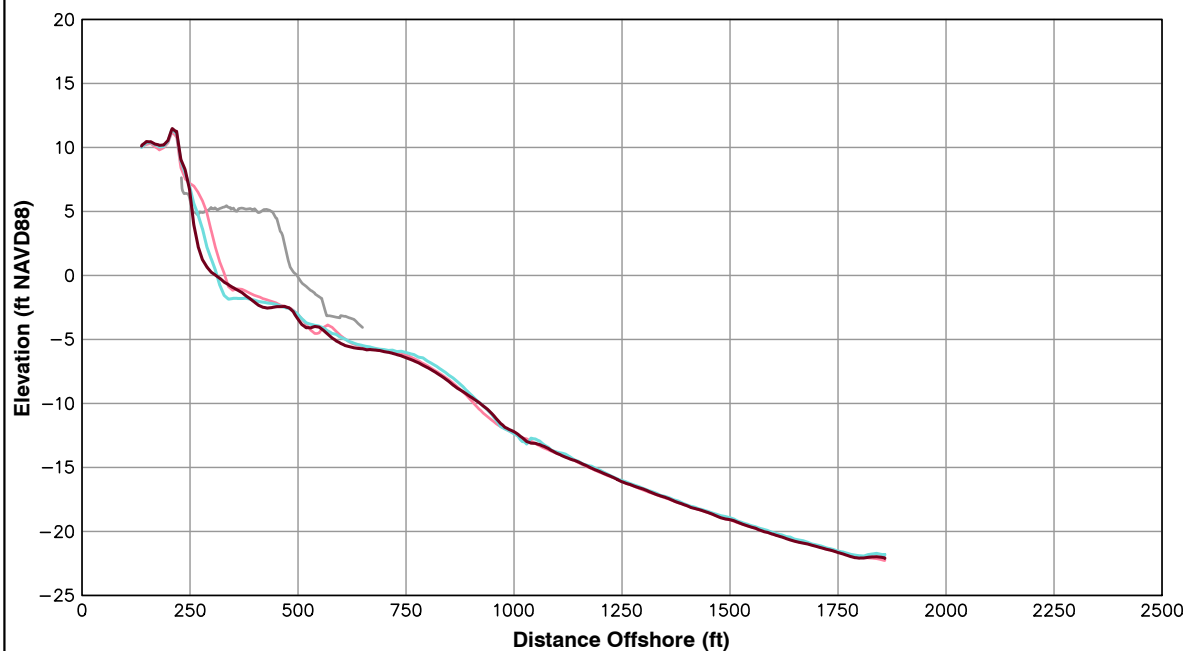
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 376+78**

**Pg 102 of 106**

**Fall 2013**





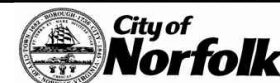
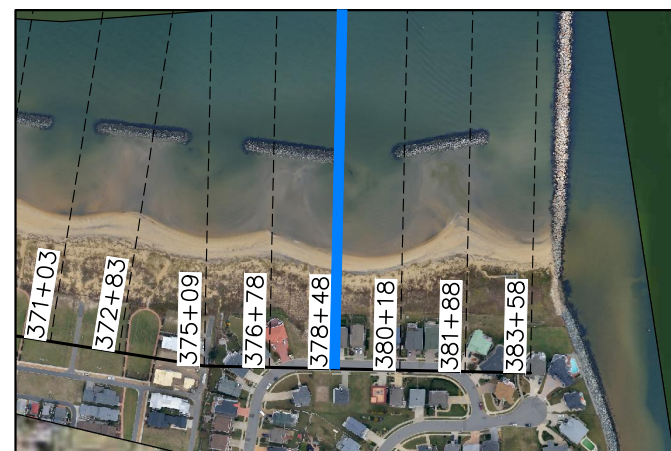
Survey Transect 378+48	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-34.40 ft/yr	-19.20 ft
Volume Change Above -15 ft NAVD88	-9.89 cy/ft/yr	-7.65 cy/ft
Volume Change Above 0 ft NAVD88	-6.98 cy/ft/yr	-3.17 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

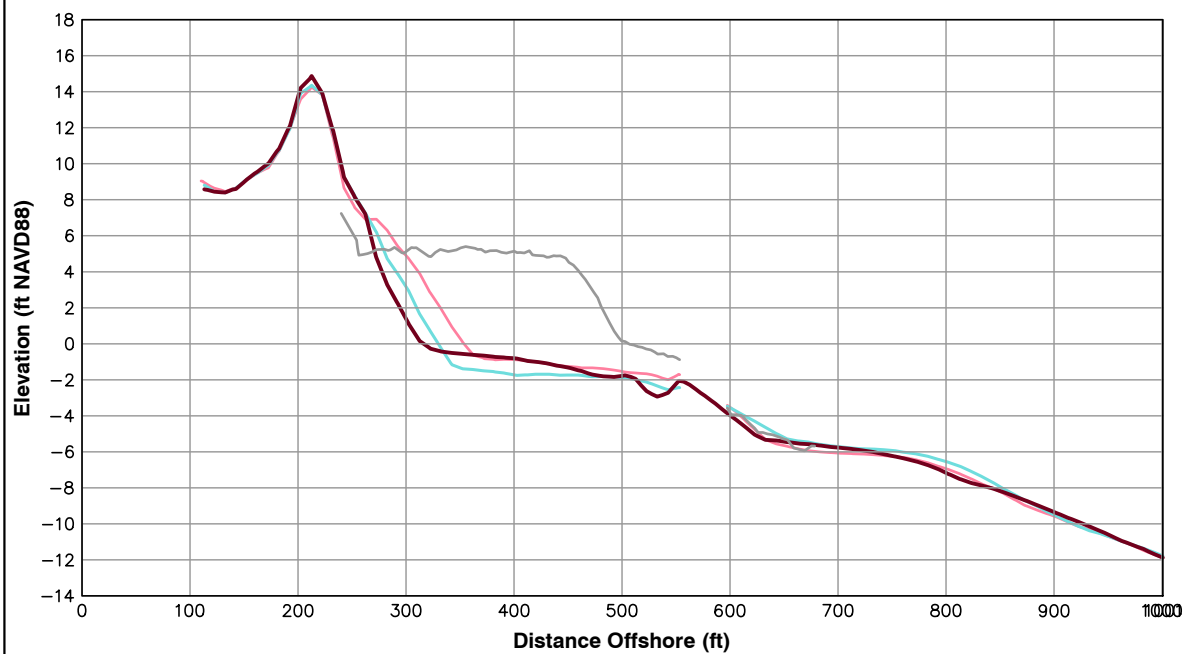
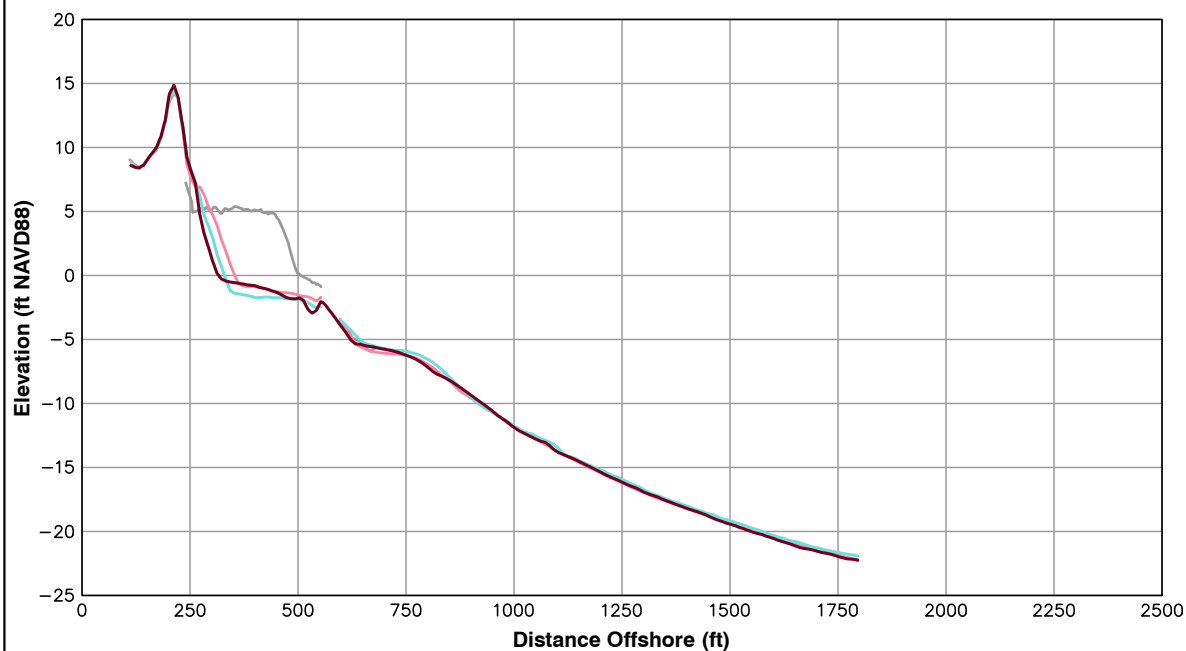


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 378+48

Pg 103 of 106

Fall 2013



Survey Transect 380+18	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-36.07 ft/yr	-15.80 ft
Volume Change Above -15 ft NAVD88	-7.43 cy/ft/yr	-3.98 cy/ft
Volume Change Above 0 ft NAVD88	-6.37 cy/ft/yr	-2.73 cy/ft

**LEGEND:**

2013 OCT —  
2013 APR —  
2012 SEP —  
POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

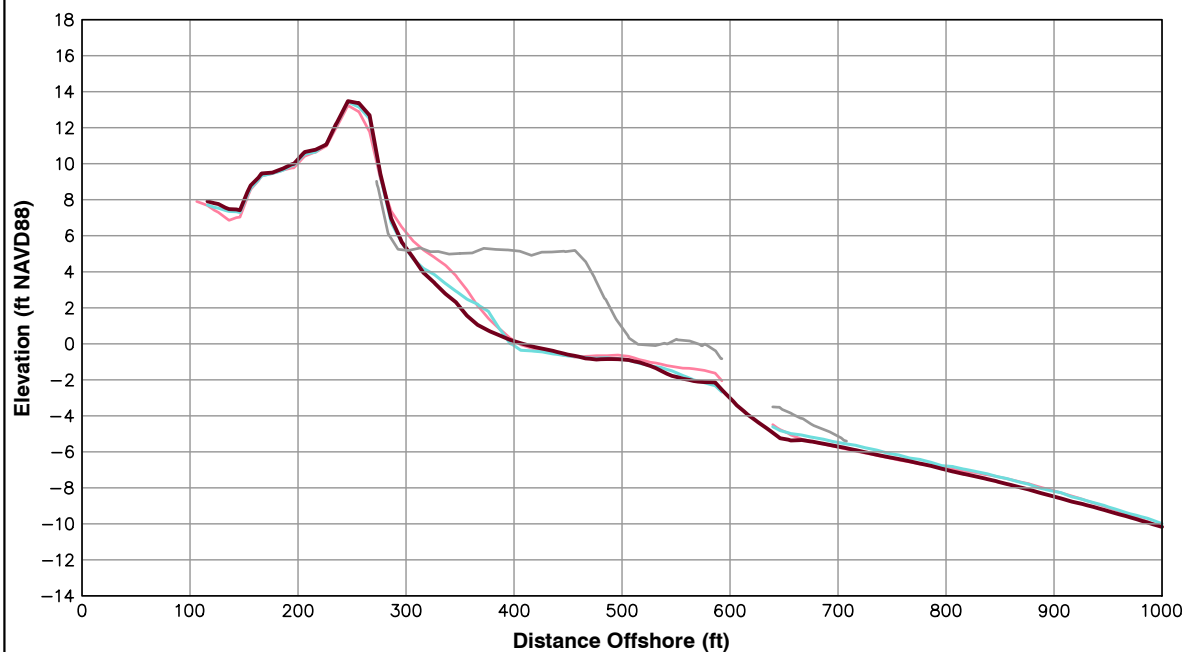
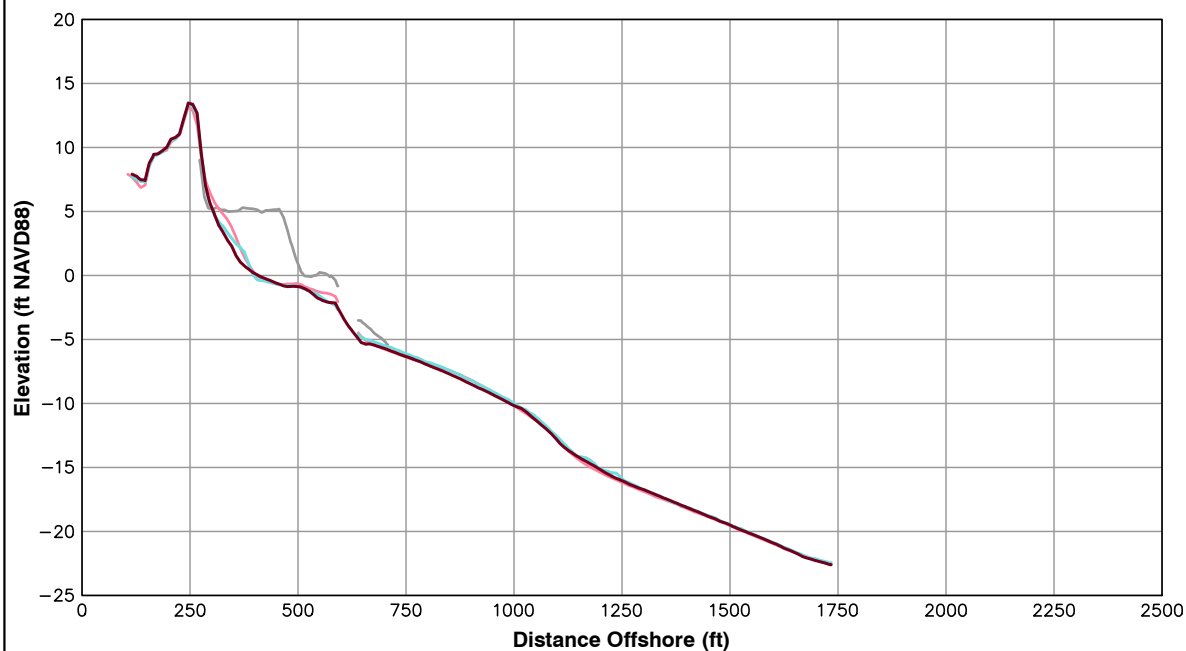


**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 380+18

Pg 104 of 106

Fall 2013



Survey Transect 381+88	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-14.44 ft/yr	-16.39 ft
Volume Change Above -15 ft NAVD88	-5.03 cy/ft/yr	-5.63 cy/ft
Volume Change Above 0 ft NAVD88	-2.32 cy/ft/yr	-1.06 cy/ft

**LEGEND:**

2013 OCT — dark red line  
 2013 APR — cyan line  
 2012 SEP — pink line  
 POST-FILL — grey line

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

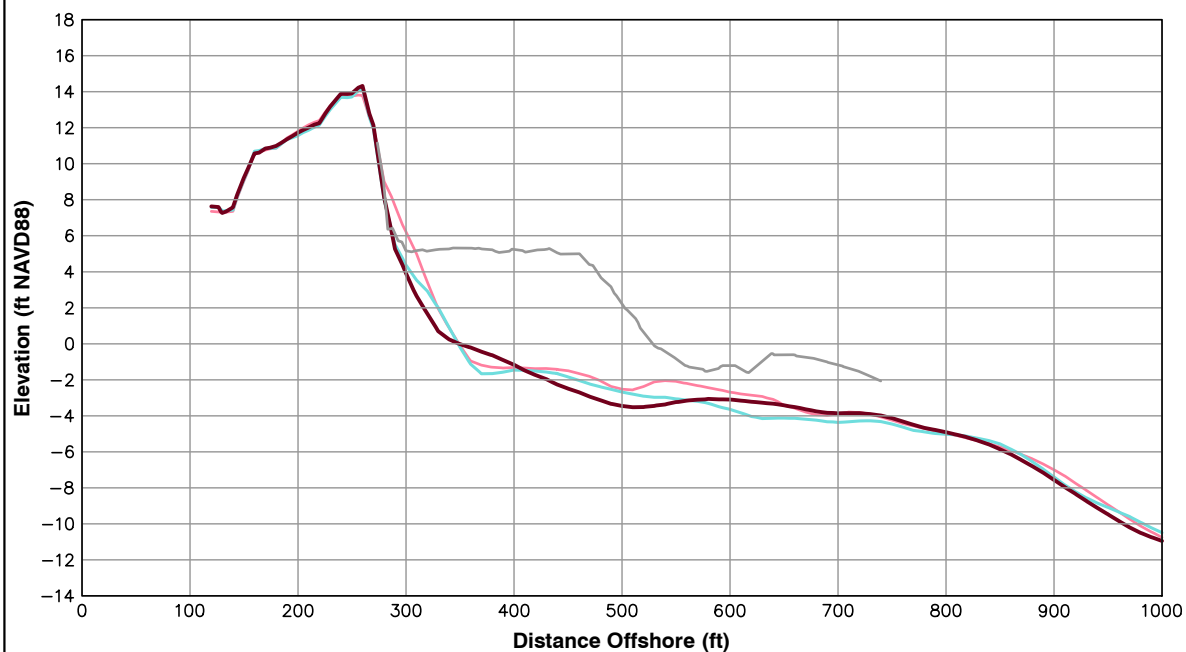
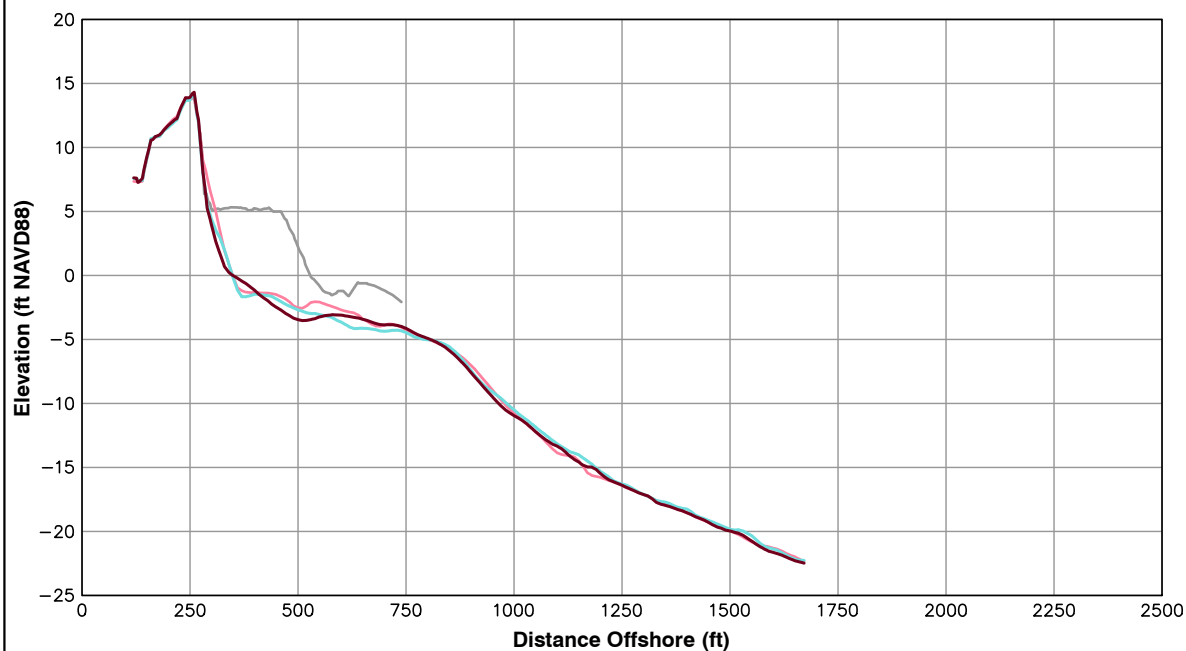
**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

ST 381+88

Pg 105 of 106

Fall 2013





Survey Transect 383+58	October 2013 - September 2012	October 2013 - April 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-10.59 ft/yr	-11.72 ft
Volume Change Above -15 ft NAVD88	-10.59 cy/ft/yr	-2.86 cy/ft
Volume Change Above 0 ft NAVD88	-3.68 cy/ft/yr	-1.12 cy/ft

**LEGEND:**

2013 OCT —  
 2013 APR —  
 2012 SEP —  
 POST-FILL —

**Notes:**

1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made To September 2012 and April 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



**City of  
Norfolk**

**OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS**

**ST 383+58**

**Pg 106 of 106**

**Fall 2013**

## **Appendix C: Summary of Shoreline Change and Volume Change Tables**

**Table C-1. Summary of Shoreline Change and Volume Change  
(September 2012 to October 2013)**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from September 26, 2012 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change Rate at MHW (ft/yr)</b>	<b>Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)</b>	<b>Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)</b>
0+00	9/26/2012	10/17/2013	45.70	13.44	30.27
2+50	9/26/2012	10/17/2013	4.26	6.69	-0.70
5+00	9/26/2012	10/17/2013	-31.53	2.40	3.91
7+50	9/26/2012	10/17/2013	-47.61	-2.73	9.74
10+00	9/26/2012	10/17/2013	-73.57	1.49	0.85
12+50	9/26/2012	10/17/2013	-79.01	-10.97	-27.52
15+00	9/26/2012	10/17/2013	-64.07	-9.51	-15.79
17+50	9/26/2012	10/17/2013	-48.53	-6.85	-11.88
20+00	9/26/2012	10/17/2013	-49.11	-7.99	-0.20
22+50	9/26/2012	10/17/2013	-36.95	-6.84	-8.04
25+00	9/26/2012	10/17/2013	74.54	7.14	13.88
27+50	9/26/2012	10/17/2013	65.10	4.90	7.85
30+00	9/26/2012	10/17/2013	42.49	5.24	14.59
32+50	9/26/2012	10/17/2013	33.59	1.24	13.01
35+00	9/26/2012	10/17/2013	52.35	8.38	31.92
37+50	9/26/2012	10/17/2013	31.16	3.39	14.00
40+00	9/26/2012	10/17/2013	57.98	6.76	15.14
42+50	9/26/2012	10/17/2013	60.03	6.28	25.81
45+00	9/26/2012	10/17/2013	55.72	5.65	4.52
45+25	9/26/2012	10/17/2013	31.07	2.91	20.92
47+30	9/26/2012	10/17/2013	35.75	5.12	27.64
49+35	9/26/2012	10/17/2013	8.90	0.66	8.99
51+41	9/26/2012	10/17/2013	7.75	0.07	13.18
53+46	9/26/2012	10/17/2013	-26.23	-4.95	-7.92
55+51	9/26/2012	10/17/2013	-4.44	-2.13	2.31
57+57	9/26/2012	10/17/2013	-27.48	-6.38	-5.80
59+62	9/26/2012	10/17/2013	-2.78	-1.31	1.17
61+62	9/26/2012	10/17/2013	-59.91	-8.31	-13.07
63+62	9/26/2012	10/17/2013	-23.77	-4.87	-9.78
65+62	9/26/2012	10/17/2013	-33.10	-8.10	-6.77
67+62	9/26/2012	10/17/2013	3.22	-0.89	-1.38
69+62	9/26/2012	10/17/2013	33.96	3.49	7.59
71+62	9/26/2012	10/17/2013	54.68	10.08	8.50
73+62	9/26/2012	10/17/2013	-21.49	-0.39	-11.77
75+62	9/26/2012	10/17/2013	-51.96	-7.84	-13.28
77+62	9/26/2012	10/17/2013	-79.44	-10.35	-17.04
79+62	9/26/2012	10/17/2013	-21.23	-4.32	-4.25
81+62	9/26/2012	10/17/2013	-10.13	-1.79	-6.80
83+62	9/26/2012	10/17/2013	-6.26	-1.38	0.38
85+62	9/26/2012	10/17/2013	-4.85	-2.45	-1.76
87+62	9/26/2012	10/17/2013	-1.31	-1.54	-3.27



**Table C-1. Summary of Shoreline Change and Volume Change  
(September 2012 to October 2013) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from September 26, 2012 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change Rate at MHW (ft/yr)</b>	<b>Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)</b>	<b>Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)</b>
93+41	9/26/2012	10/17/2013	-8.84	-1.50	1.23
103+08	9/26/2012	10/17/2013	-0.32	-0.22	-2.02
120+93	9/26/2012	10/17/2013	-1.27	0.20	-0.13
129+17	9/26/2012	10/17/2013	11.73	1.32	4.91
141+98	9/26/2012	10/17/2013	-8.60	-2.53	-0.81
152+01	9/26/2012	10/17/2013	-16.16	-2.95	-5.06
163+49	9/26/2012	10/17/2013	7.72	2.64	11.09
169+63	9/26/2012	10/17/2013	12.85	4.02	9.77
171+63	9/26/2012	10/17/2013	1.67	1.27	6.70
173+63	9/26/2012	10/17/2013	-7.54	-0.89	-4.73
175+63	9/26/2012	10/17/2013	2.95	2.33	1.79
177+63	9/26/2012	10/17/2013	-1.13	0.96	0.76
179+63	9/26/2012	10/17/2013	-13.32	-2.48	-4.37
181+63	9/26/2012	10/17/2013	6.36	3.48	8.32
183+63	9/26/2012	10/17/2013	-16.59	-0.31	-1.17
185+63	9/26/2012	10/17/2013	7.43	3.19	7.55
187+63	9/26/2012	10/17/2013	-9.40	0.67	0.50
189+63	9/26/2012	10/17/2013	8.60	3.20	6.20
191+63	9/26/2012	10/17/2013	-13.85	1.61	-3.50
193+63	9/26/2012	10/17/2013	-21.19	-1.48	-3.06
195+63	9/26/2012	10/17/2013	-16.52	-0.31	-0.48
206+86	9/26/2012	10/17/2013	-17.99	0.79	-0.99
218+66	9/26/2012	10/17/2013	-11.41	2.65	6.69
229+85	9/26/2012	10/17/2013	3.99	-1.64	14.51
242+03	9/26/2012	10/17/2013	3.64	-1.72	4.51
252+62	9/26/2012	10/17/2013	-0.61	-5.07	7.16
263+22	9/26/2012	10/17/2013	-17.24	-2.27	-2.13
274+53	9/26/2012	10/17/2013	-20.70	-1.64	5.15
281+40	9/26/2012	10/17/2013	-18.02	-3.07	-0.61
288+39	9/26/2012	10/17/2013	-7.20	-1.06	4.38
295+27	9/26/2012	10/17/2013	-7.83	-0.75	3.83
302+24	9/26/2012	10/17/2013	-14.36	3.65	1.50
315+96	9/26/2012	10/17/2013	-31.14	-8.10	-9.63
323+09	9/26/2012	10/17/2013	-12.27	-3.99	3.43
329+63	9/26/2012	10/17/2013	-10.23	-4.24	-3.14
331+43	9/26/2012	10/17/2013	-6.73	-2.29	-3.16
333+23	9/26/2012	10/17/2013	-24.73	-3.58	-2.80
335+03	9/26/2012	10/17/2013	0.57	-0.32	3.79
336+83	9/26/2012	10/17/2013	1.23	0.38	-2.26
338+63	9/26/2012	10/17/2013	9.69	1.50	6.47
340+43	9/26/2012	10/17/2013	3.83	4.54	10.73
342+23	9/26/2012	10/17/2013	4.50	1.05	-0.85

**Table C-1. Summary of Shoreline Change and Volume Change  
(September 2012 to October 2013) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from September 26, 2012 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change Rate at MHW (ft/yr)</b>	<b>Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)</b>	<b>Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)</b>
344+05	9/26/2012	10/17/2013	1.11	1.94	2.80
345+85	9/26/2012	10/17/2013	-2.42	1.43	3.34
347+63	9/26/2012	10/17/2013	-15.66	-5.95	-7.05
349+43	9/26/2012	10/17/2013	-4.74	-0.44	-0.38
351+23	9/26/2012	10/17/2013	-11.39	-3.32	-0.03
353+03	9/26/2012	10/17/2013	-1.51	0.34	3.41
354+83	9/26/2012	10/17/2013	-6.00	-1.59	-0.94
356+63	9/26/2012	10/17/2013	-5.26	-0.94	-3.57
358+43	9/26/2012	10/17/2013	-6.64	-2.18	-2.78
360+23	9/26/2012	10/17/2013	-3.14	-2.40	-4.31
362+03	9/26/2012	10/17/2013	-16.67	-3.78	-2.86
363+83	9/26/2012	10/17/2013	-8.66	-3.69	-5.21
365+63	9/26/2012	10/17/2013	-15.41	-2.21	-4.65
367+43	9/26/2012	10/17/2013	-2.87	-0.67	1.76
369+23	9/26/2012	10/17/2013	-38.16	-3.67	-3.55
371+03	9/26/2012	10/17/2013	-19.77	-2.68	5.03
372+83	9/26/2012	10/17/2013	-46.31	-4.21	-2.51
375+08	9/26/2012	10/17/2013	-18.99	-1.76	-0.66
376+78	9/26/2012	10/17/2013	-61.01	-8.32	-7.60
378+48	9/26/2012	10/17/2013	-34.40	-6.98	-9.89
380+18	9/26/2012	10/17/2013	-36.07	-6.37	-7.43
381+88	9/26/2012	10/17/2013	-14.44	-2.32	-5.03
383+58	9/26/2012	10/17/2013	-10.59	-3.68	-10.59

**Table C-2. Summary of Shoreline Change and Volume Change  
(April 2013 to October 2013)**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from April 2, 2013 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change at MHW (ft)</b>	<b>Volume Change Above 0 ft NAVD88 (cy/ft)</b>	<b>Volume Change Above -15 ft NAVD88 (cy/ft)</b>
0+00	4/2/2013	10/17/2013	38.17	8.67	-10.23
2+50	4/2/2013	10/17/2013	0.88	0.89	-13.00
5+00	4/2/2013	10/17/2013	-12.01	-0.96	-10.69
7+50	4/2/2013	10/17/2013	-15.31	-2.37	-1.56
10+00	4/2/2013	10/17/2013	8.24	0.38	-5.44
12+50	4/2/2013	10/17/2013	16.81	2.18	-19.20
15+00	4/2/2013	10/17/2013	-18.29	-1.88	-16.46
17+50	4/2/2013	10/17/2013	-35.51	-8.96	-18.61
20+00	4/2/2013	10/17/2013	-58.37	-10.88	-19.21
22+50	4/2/2013	10/17/2013	-35.74	-7.75	-15.18
25+00	4/2/2013	10/17/2013	42.11	4.04	10.03
27+50	4/2/2013	10/17/2013	11.16	1.99	-8.50
30+00	4/2/2013	10/17/2013	-38.66	-5.51	-17.85
32+50	4/2/2013	10/17/2013	-17.80	-3.58	-10.04
35+00	4/2/2013	10/17/2013	0.32	0.58	19.68
37+50	4/2/2013	10/17/2013	24.68	3.89	9.32
40+00	4/2/2013	10/17/2013	54.18	7.21	19.10
42+50	4/2/2013	10/17/2013	59.66	6.24	21.42
45+00	4/2/2013	10/17/2013	69.92	9.03	2.80
45+25	4/2/2013	10/17/2013	42.48	5.83	14.55
47+30	4/2/2013	10/17/2013	34.44	5.52	23.38
49+35	4/2/2013	10/17/2013	9.82	2.25	5.33
51+41	4/2/2013	10/17/2013	7.08	1.13	6.90
53+46	4/2/2013	10/17/2013	-12.57	-1.54	-5.21
55+51	4/2/2013	10/17/2013	1.82	-0.11	0.25
57+57	4/2/2013	10/17/2013	-39.22	-4.58	-11.20
59+62	4/2/2013	10/17/2013	-6.74	-1.64	-5.15
61+62	4/2/2013	10/17/2013	-45.33	-5.69	-14.08
63+62	4/2/2013	10/17/2013	-11.99	-2.93	-12.46
65+62	4/2/2013	10/17/2013	-34.18	-6.41	-12.41
67+62	4/2/2013	10/17/2013	5.15	0.40	-2.08
69+62	4/2/2013	10/17/2013	21.36	3.93	1.12
71+62	4/2/2013	10/17/2013	42.30	8.33	-0.51
73+62	4/2/2013	10/17/2013	-76.60	-6.71	-21.59
75+62	4/2/2013	10/17/2013	-31.34	-6.56	-12.43
77+62	4/2/2013	10/17/2013	-58.10	-7.62	-15.60
79+62	4/2/2013	10/17/2013	-2.73	-1.19	-0.95
81+62	4/2/2013	10/17/2013	-7.93	-1.47	-5.48
83+62	4/2/2013	10/17/2013	-14.98	-3.69	-11.39
85+62	4/2/2013	10/17/2013	2.26	-0.41	-4.77
87+62	4/2/2013	10/17/2013	3.99	0.36	-2.88



**Table C-2. Summary of Shoreline Change and Volume Change  
(April 2013 to October 2013) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from April 2, 2013 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change at MHW (ft)</b>	<b>Volume Change Above 0 ft NAVD88 (cy/ft)</b>	<b>Volume Change Above -15 ft NAVD88 (cy/ft)</b>
93+41	4/2/2013	10/17/2013	-5.29	-0.78	-4.01
103+08	4/2/2013	10/17/2013	-2.05	-0.82	-8.13
120+93	4/2/2013	10/17/2013	0.58	-0.69	-0.99
129+17	4/2/2013	10/17/2013	14.03	3.12	4.69
141+98	4/2/2013	10/17/2013	-9.35	-3.22	-5.70
152+01	4/2/2013	10/17/2013	7.89	0.74	0.46
163+49	4/2/2013	10/17/2013	12.63	3.32	9.62
169+63	4/2/2013	10/17/2013	-8.12	-0.10	-2.37
171+63	4/2/2013	10/17/2013	-3.32	0.32	0.31
173+63	4/2/2013	10/17/2013	-9.16	-1.81	-9.04
175+63	4/2/2013	10/17/2013	-1.25	-0.87	-7.48
177+63	4/2/2013	10/17/2013	-9.22	-1.31	1.83
179+63	4/2/2013	10/17/2013	-15.42	-2.68	-7.94
181+63	4/2/2013	10/17/2013	6.65	1.89	2.50
183+63	4/2/2013	10/17/2013	-11.49	-0.38	0.00
185+63	4/2/2013	10/17/2013	4.23	1.02	0.39
187+63	4/2/2013	10/17/2013	-11.64	-0.60	-5.10
189+63	4/2/2013	10/17/2013	7.95	2.17	3.70
191+63	4/2/2013	10/17/2013	-6.08	0.42	-3.81
193+63	4/2/2013	10/17/2013	4.70	0.13	2.25
195+63	4/2/2013	10/17/2013	6.31	1.49	6.14
206+86	4/2/2013	10/17/2013	-13.23	-3.46	-8.88
218+66	4/2/2013	10/17/2013	-2.82	-0.09	1.07
229+85	4/2/2013	10/17/2013	8.53	-3.18	2.09
242+03	4/2/2013	10/17/2013	14.41	0.47	1.13
252+62	4/2/2013	10/17/2013	-5.12	-6.15	-1.53
263+22	4/2/2013	10/17/2013	1.88	-0.06	0.04
274+53	4/2/2013	10/17/2013	-7.39	-0.27	6.57
281+40	4/2/2013	10/17/2013	-10.99	-2.11	-1.77
288+39	4/2/2013	10/17/2013	-13.49	-3.70	-4.49
295+27	4/2/2013	10/17/2013	-2.64	-3.41	-1.55
302+24	4/2/2013	10/17/2013	-6.83	3.53	4.05
315+96	4/2/2013	10/17/2013	-18.15	-3.92	-5.17
323+09	4/2/2013	10/17/2013	-7.62	-3.66	-9.87
329+63	4/2/2013	10/17/2013	-5.05	-2.70	-8.37
331+43	4/2/2013	10/17/2013	-8.56	-1.19	-6.26
333+23	4/2/2013	10/17/2013	-16.52	-4.30	-3.49
335+03	4/2/2013	10/17/2013	6.19	-1.44	-3.90
336+83	4/2/2013	10/17/2013	7.07	-0.06	-7.14
338+63	4/2/2013	10/17/2013	18.68	0.95	0.84
340+43	4/2/2013	10/17/2013	13.93	0.57	-1.90

**Table C-2. Summary of Shoreline Change and Volume Change**

**(April 2013 to October 2013) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from April 2, 2013 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change at MHW (ft)</b>	<b>Volume Change Above 0 ft NAVD88 (cy/ft)</b>	<b>Volume Change Above -15 ft NAVD88 (cy/ft)</b>
342+23	4/2/2013	10/17/2013	8.40	0.87	-9.42
344+05	4/2/2013	10/17/2013	5.69	2.30	1.77
345+85	4/2/2013	10/17/2013	2.15	1.04	-2.16
347+63	4/2/2013	10/17/2013	-8.03	-2.53	-8.27
349+43	4/2/2013	10/17/2013	0.67	0.75	-2.77
351+23	4/2/2013	10/17/2013	-2.48	-0.67	-3.15
353+03	4/2/2013	10/17/2013	6.98	1.21	-1.74
354+83	4/2/2013	10/17/2013	-0.46	-1.99	-3.33
356+63	4/2/2013	10/17/2013	1.56	0.73	1.43
358+43	4/2/2013	10/17/2013	-1.00	-1.72	-1.46
360+23	4/2/2013	10/17/2013	2.42	0.16	0.11
362+03	4/2/2013	10/17/2013	-11.23	-2.16	-3.43
363+83	4/2/2013	10/17/2013	-9.14	-1.72	-2.27
365+63	4/2/2013	10/17/2013	-8.45	-2.23	-5.02
367+43	4/2/2013	10/17/2013	-0.25	0.54	2.04
369+23	4/2/2013	10/17/2013	-34.86	-3.79	-7.83
371+03	4/2/2013	10/17/2013	-14.27	-0.96	4.96
372+83	4/2/2013	10/17/2013	-44.97	-5.83	-8.89
375+08	4/2/2013	10/17/2013	-10.10	-0.86	-4.82
376+78	4/2/2013	10/17/2013	-41.36	-5.59	-10.62
378+48	4/2/2013	10/17/2013	-19.20	-3.17	-7.65
380+18	4/2/2013	10/17/2013	-15.80	-2.73	-3.98
381+88	4/2/2013	10/17/2013	-16.39	-1.06	-5.63
383+58	4/2/2013	10/17/2013	-11.72	-1.12	-2.86

**Table C-3. Summary of Shoreline Change and Volume Change from  
East Ocean View Nourishment (March 2009 to October 2013)**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from March 20, 2009 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change Rate at MHW (ft/yr)</b>	<b>Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)</b>	<b>Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)</b>
329+63	3/20/2009	10/17/2013	-21.23	-4.76	-
331+43	3/20/2009	10/17/2013	-21.63	-4.02	-
333+23	3/20/2009	10/17/2013	-16.83	-3.14	-
335+03	3/20/2009	10/17/2013	-13.18	-2.49	-
336+83	3/20/2009	10/17/2013	-13.49	-2.47	-
338+63	3/20/2009	10/17/2013	-10.45	-2.32	-
340+43	3/20/2009	10/17/2013	-13.87	-2.04	-
342+23	3/20/2009	10/17/2013	-15.61	-2.51	-
344+05	3/20/2009	10/17/2013	-15.74	-3.43	-
345+85	3/20/2009	10/17/2013	-14.59	-3.15	-
347+63	3/20/2009	10/17/2013	-12.18	-3.23	-
349+43	3/20/2009	10/17/2013	-15.23	-3.33	-
351+23	3/20/2009	10/17/2013	-10.09	-2.89	-
353+03	3/20/2009	10/17/2013	-13.39	-2.86	-
354+83	3/20/2009	10/17/2013	-9.16	-2.57	-
356+63	3/20/2009	10/17/2013	-14.46	-3.34	-
358+43	3/20/2009	10/17/2013	-12.90	-3.00	-
360+23	3/20/2009	10/17/2013	-18.10	-3.80	-
362+03	3/20/2009	10/17/2013	-15.27	-3.31	-
363+83	3/20/2009	10/17/2013	-12.96	-2.96	-
365+63	3/20/2009	10/17/2013	-10.61	-2.57	-
367+43	3/20/2009	10/17/2013	-20.03	-3.74	-
369+23	3/20/2009	10/17/2013	-20.51	-3.40	-
371+03	3/20/2009	10/17/2013	-26.07	-4.66	-
372+83	3/20/2009	10/17/2013	-29.56	-5.35	-
375+08	3/20/2009	10/17/2013	-34.09	-6.48	-
376+78	3/20/2009	10/17/2013	-31.69	-5.58	-
378+48	3/20/2009	10/17/2013	-42.73	-7.89	-
380+18	3/20/2009	10/17/2013	-40.67	-7.13	-
381+88	3/20/2009	10/17/2013	-28.51	-5.67	-
383+58	3/20/2009	10/17/2013	-41.21	-7.72	-

**Table C-4. Summary of Shoreline Change and Volume Change from  
Central Ocean View Nourishment (March 2005 to October 2013)**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from March 15, 2005 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change Rate at MHW (ft/yr)</b>	<b>Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)</b>	<b>Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)</b>
15+00	3/15/2005	10/17/2013	-2.83	0.35	-
17+50	3/15/2005	10/17/2013	0.92	0.48	-
20+00	3/15/2005	10/17/2013	-3.29	-0.88	-
22+50	3/15/2005	10/17/2013	-7.83	-2.78	-
25+00	3/15/2005	10/17/2013	5.94	-1.37	-
27+50	3/15/2005	10/17/2013	2.65	-1.67	-
30+00	3/15/2005	10/17/2013	2.33	-0.98	-
32+50	3/15/2005	10/17/2013	-1.09	-1.85	-
35+00	3/15/2005	10/17/2013	0.59	-0.59	-
37+50	3/15/2005	10/17/2013	0.16	-1.44	-
40+00	3/15/2005	10/17/2013	-0.57	-1.33	-
42+50	3/15/2005	10/17/2013	0.92	-1.70	-
45+00	3/15/2005	10/17/2013	-1.14	-2.04	-
45+25	3/15/2005	10/17/2013	-5.29	-2.41	-
47+30	3/15/2005	10/17/2013	-7.17	-2.67	-
49+35	3/15/2005	10/17/2013	-5.38	-2.09	-
51+41	3/15/2005	10/17/2013	-5.40	-1.61	-
53+46	3/15/2005	10/17/2013	-4.01	-1.24	-
55+51	3/15/2005	10/17/2013	-7.63	-2.53	-
57+57	3/15/2005	10/17/2013	-3.14	-1.26	-
59+62	3/15/2005	10/17/2013	-7.11	-2.06	-
61+62	3/15/2005	10/17/2013	-0.83	-0.11	-
63+62	3/15/2005	10/17/2013	-6.50	-0.92	-
65+62	3/15/2005	10/17/2013	-4.86	-0.24	-
67+62	3/15/2005	10/17/2013	-14.34	-1.87	-
69+62	3/15/2005	10/17/2013	-4.93	-0.56	-
71+62	3/15/2005	10/17/2013	-11.16	-1.58	-
73+62	3/15/2005	10/17/2013	-6.25	-0.59	-
75+62	3/15/2005	10/17/2013	-8.11	-0.82	-
77+62	3/15/2005	10/17/2013	-2.37	0.83	-
79+62	3/15/2005	10/17/2013	-3.22	-0.59	-
81+62	3/15/2005	10/17/2013	-4.03	-1.19	-
83+62	3/15/2005	10/17/2013	-6.89	-2.19	-
85+62	3/15/2005	10/17/2013	-3.26	-1.56	-
87+62	3/15/2005	10/17/2013	-2.55	-0.72	-
93+41	3/15/2005	10/17/2013	-1.03	-1.01	-
103+08	3/15/2005	10/17/2013	-3.89	-1.65	-
120+93	3/15/2005	10/17/2013	-5.69	-2.63	-
129+17	3/15/2005	10/17/2013	-7.92	-3.64	-
141+98	3/15/2005	10/17/2013	-4.41	-1.60	-
152+01	3/15/2005	10/17/2013	-5.24	-2.05	-



**Table C-4. Summary of Shoreline Change and Volume Change from  
Central Ocean View Nourishment (March 2005 to October 2013) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from March 15, 2005 to October 17, 2013.

<b>Transect Number (Station)</b>	<b>Old Survey Date</b>	<b>New Survey Date</b>	<b>Shoreline Change Rate at MHW (ft/yr)</b>	<b>Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)</b>	<b>Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)</b>
163+49	3/15/2005	10/17/2013	-2.55	-1.32	-
169+63	3/15/2005	10/17/2013	-1.45	-0.84	-
171+63	3/15/2005	10/17/2013	-3.85	-1.10	-
173+63	3/15/2005	10/17/2013	-3.40	-1.43	-
175+63	3/15/2005	10/17/2013	-5.47	-1.35	-
177+63	3/15/2005	10/17/2013	-4.77	-1.14	-
179+63	3/15/2005	10/17/2013	-5.87	-1.63	-
181+63	3/15/2005	10/17/2013	-3.26	-1.52	-
183+63	3/15/2005	10/17/2013	-0.74	-0.18	-
185+63	3/15/2005	10/17/2013	-1.37	-0.40	-
187+63	3/15/2005	10/17/2013	3.57	1.23	-
189+63	3/15/2005	10/17/2013	0.39	0.87	-
191+63	3/15/2005	10/17/2013	5.19	1.98	-
193+63	3/15/2005	10/17/2013	-0.94	0.60	-
195+63	3/15/2005	10/17/2013	-0.78	0.38	-